United States Court of Appeals

for the Second Circuit

SUPPLEMENTAL APPENDIX

74-2284

Nos. 74-2345, 74-2284, 74-2286,
74-2308, 74-2449, & 74-2456

IN THE UNITED STATES COURT OF APPEALS
FOR THE SECOND CIRCUIT

B
PIS

THE B.F. GOODRICH COMPANY,

Petitioner,

v.

PETER J. BRENNAN, ET AL.,

Respondents.

THE SOCIETY OF THE PLASTICS INDUSTRY, INC.,

Petitioner,

v.

OCCUPATIONAL SAFETY AND HEALTH
ADMINISTRATION, ET AL.,

Respondents.

HOOKER CHEMICALS & PLASTICS CORPORATION,

Petitioner,

v.

OCCUPATIONAL SAFETY AND HEALTH
ADMINISTRATION, ET AL.,

Respondents.

UNION CARBIDE CORPORATION,

Petitioner,

v.

UNITED STATES DEPARTMENT OF LABOR, ET AL.,

Respondents.

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VOLUME II

PAGINATION AS IN ORIGINAL COPY

AIR PRODUCTS AND CHEMICALS, INC.,

Petitioner,

v.

OCCUPATIONAL SAFETY & HEALTH ADMINISTRATION, ET AL.,

Respondents.

TENNECO CHEMICAL, INC.,

Petitioner,

v.

OCCUPATIONAL SAFETY & HEALTH ADMINISTRATION, ET AL.,

Respondents.

SUPPLEMENTAL APPENDIX

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Diamond. Production of PVC by these methods involves many stages and operations.

First is the reaction section containing numerous pressure vessels. This is a batch operation with vessels being continuously filled, discharged, and opened for cleaning.

Downstream from the reaction section is the slurry processing section where most, but not all, unreacted VCM is removed and recovered for reuse, and the PVC powder is separated from the carrier liquid, usually water.

The PVC powder is then dried in rotary, fluid bed, flash, or spray dryers, and is then stored in silos for final packaging; or is processed through compounding mixers, mills and extruders before packaging. Each of these operations releases a small but measurable amount of VCM.

In June of 1973, we began an intensive effort to locate sources of emissions of VCM in our plants, and instituted an ongoing program of reduction or, where possible, elimination of those emissions.

In March of this year, our company formed three engineering teams to determine the feasibility and means of reducing VCM in plant air to an undetectable level -- less than 1 ppm.

This task force identified over 500 potential sources of vinyl chloride exposure in our facilities. In their opinion, VCM emissions from these sources could be reduced considerably but not to anywhere near an undetectable level.

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A difference in product mix also affects the two plants. Some products will provide higher levels than others.

MR. KLEIN: Could you go into that a little bit and tell us which products it is that have a higher exposure level?

MR. CONNORS: Well, there are different types of -- I'm not prepared to go into too much detail on it, but we do have, particularly one product, at Delaware City where we invariably get higher worker exposures in several areas in the plant. It's simply because the resin is not as easily depleted of unreacted vinyl chloride monomer.

MR. KLEIN: Which resin is that, sir?

MR. CONNORS: Is it necessary that we discuss that, or that I answer that?

MR. KLEIN: Well, I think that --

MR. CONNORS: To some extent it might be proprietary information.

MR. KLEIN: Well, I guess that will have to --

MR. CONNORS: I can tell you the general type. It's a suspension resion, a suspension produced resin which has special uses in plastisols.

MR. KLEIN: Now, are there -- I'm just talking about major engineering controls and work practices now. Are there --

MR. WILLIAMS: I'm sorry, I wasn't listening.

MR. KLEIN: You're probably not the only one!

[Laughter.]

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you tell us the engineering controls that you have instituted and the work practices which you've instituted at each of the plants in order to reduce the level, please?

MR. WILLIAMS: As I've mentioned, many of these were started last year. It's kind of hard to break out the list as to what has been done the last few months and what has been done in the last year.

So I will just mention some of these. Some of them are long-term projects that are just now being completed, but one would be rerouting process vents into non-occupied areas. This is not a reproduction, it's a relocation.

Of significance, I think, in reducing personnel exposure is just operator awareness, operator training, that there is a problem with inhalation of vinyl, so stand upwind instead of downwind when you're doing the job. I think this means a lot.

1073 We have significantly modified our reactor entry procedures, and by that I mean we have put in the hands of the operators better instruments. For many years, the only instrument they had to check if a vessel was clear of vinyl was a MSA or some similar exposure meter.

Now they have instruments that can tell them what the level is, and you can really control the -- give them a number that is meaningful to limit vessel entry.

I think that's significant.

We have also, have installed at Delaware City and are installing at Deer Park an improved reactor purging procedure, better ventilation of the reactors, before and during -- before entry and during the time the man is in the reactor.

We are a licensee of the B. F. Goodrich hydraulic cleaning system, which is about one-third of our total facility at this moment, and will be in the rest by the end of '74.

Do you want some more?

MR. KLEIN: Please.

MR. WILLIAMS: We have done quite a bit in vapor recovery systems. Much of this was at the, I guess you'd say, insistence of the Texas Air Control Board instead of OSHA, but there have been reductions in general vent emissions. We have added new gas holders in our recovery system, we've added new compressors, we've added new condensers. We've replaced some compressors with more dependable compressors.

1074 A periodic problem that we've had is, I think it must have been Dow that mentioned it, changing filters. This is a weekly occurrence, and that is now vented back to the recovery system and also hooked up to compressors to evacuate before the man can remove the cover.

One thing that I consider significant, and it is, in a way, brought out in some of the other parts of my testimony, is improved control room ventilation. This is another OSHA

requirement on pressurization of equipment rooms.

We are just going through that. We have very low levels in our control rooms where, of course, the men spend as much time as possible, since it's air-conditioned and the rest of the plant isn't. And that's important down south.

As far as real quick things we've done in the last three months, we knew of some problem areas, and built real quickly galvanized hoods for these pieces of equipment, and vented them to non-occupied areas.

These things, like that, that have been very significant in the reduction we've made over the last few months.

MR. KLEIN: Do you have this centrifugal forces to help prevent leaks in your system?

MR. WILLIAMS: The centrifugal compressors that Dow was talking about?

MR. KLEIN: Yes.

MR. WILLIAMS: No, ours are not centrifugal. We

1075 did have two reciprocating compressors which were a problem, and we replaced it with a vein type compressor.

MR. KLEIN: Let's talk for a brief moment about respirators.

You talk about use of respirators for short duration with significant VC concentrations.

The first question is: What do you consider a shor

duration?

MR. WILLIAMS: In our Delaware City plant right now, we have perhaps 25 percent of our people in respirators for a minor part of their day; somewhat less in Deer Park.

To me, a significant length of time would be over a couple of hours out of their eight hours, I would think.

MR. KLEIN: Do your employees presently wear respirators for, say, a couple of hours at a time, two or three hours?

MR. WILLIAMS: No, it's not continuous. They will wear it, say, 15 minutes this hour and maybe 15 minutes the next hour. And maybe it works up to two hours on some of the worst situations that we have.

MR. KLEIN: And in terms of respirators, what would you consider to be a significant VC concentration, that would trigger the wearing of a respirator?

MR. WILLIAMS: Whatever you set the standard at.

MR. KLEIN: Are there any places in either of your plants where you have a no-detectable level?

MR. WILLIAMS: Define "no detectable".

MR. KLEIN: Plus -- one part per million plus or minus 50 percent.

MR. WILLIAMS: Is that -- would anything less than one part per million be undetectable?

MR. KLEIN: I thought I was supposed to ask the questions.

longer competitive with monomer produced by other processes.

So that from a profit standpoint we improved the situation by shutting it down.

As far as employment went, the number of employees related to that -- a very small plant, I might add, it was economically unsound -- it was too small to be any longer economical; they were simply absorbed into employment in the works, in our over-all works, both PVC and other operations.

MR. ROMULUS: Was the value of the equipment and so forth involved with that production of, I think it was in the range of, 100 million pounds capacity, in any way a financial burden by shutting that operation down?

MR. CONNORS: We had a write-off. So it was a financial burden, from that standpoint. We had to absorb a substantial dollar write-off.

MR. ROMULUS: But it did not have any impact upon your over-all chemical operations, sales, and profit picture?

MR. CONNORS: Oh, certainly, it reduced our profit
1083 by the amount of the write-off.

On the other hand, I've already said that it had become obsolete, so that it no longer carried itself.

I don't know what -- I'm not sure what you're getting at, but --

MR. ROMULUS: Well, I think that, you know, these changes in the past, in terms of shutdowns, may lend, you know,

some information as to the current condition in polyvinyl chloride plants and if some are obsolete and shut down.

MR. CONNORS: This was a -- let me just repeat -- this was a very small unit by any stand, and it had been in operation for quite a few years, so that it would have been written off, to a large extent.

MR. ROMULUS: I understand that you have under construction an expansion at your Deer Park facility of approximately 200 million pounds for polyvinyl chloride; is that true?

MR. CONNORS: That's true.

MR. ROMULUS: Is there a recognition currently within the industry that the smaller and older polyvinyl chloride plants are becoming inefficient and obsolete?

MR. CONNORS: No, I don't think you could make that as a general statement.

Remember that in PVC there are many varieties of resin produced. Some of them may be more economically produced in older and smaller -- or, let's say, in smaller equipment,

1084 and can be perfectly well produced in a smaller plant or older plant.

MR. ROMULUS: Well, sort of the reason why I asked that is, I have noticed that in four new polyvinyl chloride plants that are being planned, all of them are large plants, over 200 million pounds of capacity; and the six expansions by

various companies are also in the range of these large amounts; and of course in your Deer Park facility, on the border of a 200 million pound facility. Is this at least recognition that these larger plants are the ones which can be competitive and efficient operations?

MR. CONNORS: In building new facilities at today's high construction costs, there's obviously a tendency to build them to a larger -- it becomes economically feasible, usually, to build them to a larger capacity than formerly.

Also, the market is much larger, it will absorb much larger increments today than it would have, let's say ten or 30, or 20 years ago.

You can visualize selling out the capacity of a 200 million pound per year plant soon enough to save your neck today, when you could not have before.

MR. ROMULUS: When was the Deer Park expansion begun in terms of actual construction, and when will it be completed?

MR. CONNORS: It was begun in about January of 1973, and will be completed about January of 1975.

1085 MR. ROMULUS: Do you anticipate any problems in terms of the market, of being able to support expansions and capital outlays in terms of returns upon the sales of polyvinyl chloride on the price of these products?

In other words, do your market conditions, either currently or what you expect, do they support large capital

outlays in construction and the like, within the polyvinyl chloride field?

MR. CONNORS: The demand for polyvinyl chloride has exceeded the supply for some time. The growth has been great. And it would seem that the demand will continue strong for quite a few years.

Therefore, additional facilities would seem to be in order.

MR. ROMINES: And the market conditions support a profitability which can justify large expenditures and capital outlays in this area?

MR. CONNORS: Sufficient, so that these expansions are being made that today, if the market conditions several years ago -- and incidentally, I'm not sure what this has to do with the subject of this hearing -- were such that they would not support them. But then there was overcapacity in the industry, there was no new plant, no new plants were being constructed. The margins were low, they were not justified.

That picture has changed in the last several years.

1036 MR. ROMINES: I've noticed in Chemical Weekly that the capital outlays for your company in 1973 were $30 million, for 1974 estimated to be $75 million.

What are the amounts which you are spending in these capital outlays upon safety procedures?

MR. CONNORS: I can't speak for the entire company.

University of Louisville School of Medicine.

Dr. Moore will present a statement summarizing the program which the University is initiating pursuant to a grant from Goodrich.

The main purpose of my testimony will be to examine the question of technical feasibility in the light of our current engineering and scientific knowledge.

In addition, I will discuss on-going research and development programs directed at the reduction of vinyl chloride losses from our manufacturing operations. Our goal is to reduce vinyl chloride exposure to the lowest feasible levels and to preserve the jobs dependent upon this widely used and versatile plastic material.

We will discuss these subjects in terms of our own extensive experience. Specifically, we will review:

1. Vinyl chloride exposure levels in Goodrich plants.

2. Our current programs to reduce exposure levels, including engineering, work practices, and training.

3. Our research and development programs to further reduce exposure levels in the future.

We will conclude with our position on certain aspects of the proposed permanent standard.

Goodrich is a major producer in the U. S. polyvinyl chloride (PVC) industry. We began commercial production of

polyvinyl chloride resins and compounds in 1937. We currently operate five polyvinyl chloride plants -- at Louisville, Kentucky; Avon Lake, Ohio; Long Beach, California; Henry, Illinois; and Pedricktown, New Jersey. We supply finished resins and compounds to about 2,200 domestic customer plants.

We also operate a vinyl chloride monomer plant at Calvert City, Kentucky. We buy, sell, produce, and use vinyl chloride, and our monomer and polymer capacity represents approximately 15 to 18 percent of the domestic capacity for these products. We employ about 1,500 workers in vinyl chloride, polyvinyl chloride, and compounding operations. (See Exhibit 1.)

Review of levels of exposure to vinyl chloride -- over the years, our Company has sought to provide a safe working environment through two basic means -- containment of known or potentially toxic materials during the manufacturing process, and protection of our employees through work practices, education and equipment.

Our efforts to provide a safe working environment have generally paralleled known scientific information or data relating to levels of exposure. This has resulted in decreasing levels of exposure with time.

The properties of vinyl chloride have been frequently and adequately described by other witnesses. I will review briefly the characteristics most important in PVC production. It has an intoxicating effect in concentrations of about 5,000

gas. The process is batch-type and, after each reaction is completed, the vessel in which it is conducted requires varying kinds of purging, entering, cleaning, and preparation before the next batch can be started. These vessels, which we call poly-merizers or reactors, have gone through an engineering evolution over the past 35 years.

During our first 20 years in the business, we used 1,100 gallon reactors of stainless steel construction, which required entry and manual cleaning after every charge. This cleaning took about one hour, during which time workers cleaning vessels were exposed to vinyl chloride levels of an estimated 200 to 500 ppm. The worker would clean an average of five vessels every eight hour work shift.

We can only estimate early exposure levels, since the analytical sophistication to determine low levels of vinyl chloride in air has only been available in recent years. Our estimates were based on fragmentary data and interviews with employees to determine how often odor was evident, if and when they were aware of the intoxicating effect, and what level of explosimeter readings they might recall.

While this method used to estimate exposure levels may seem crude by today's standards, our estimates are consistent with other similar testimony presented in this hearing.

Peak exposure levels ten and 20 years ago were per-haps one hundred times today's average levels. My personal

PVC experience goes back to when levels of exposure were of that magnitude.

Beginning in 1959, we experimented with glass-lined polymizers and revisions to agitators and baffles to minimize and buildup and cleaning time and did, as a result, reduce cleaning time to 20 to 30 minutes.

The next engineering breakthrough occurred in the late 1960's, with the Goodrich development of hydraulic reactor cleaning. This is a programmed high pressure water mechanism which is inserted into a polymerizer to remove buildup almost completely. This has greatly reduced human entry into polymerizers for manual cleaning.

On some of our products, human entry has been reduced to as few as three percent of the batches. On some products, entry is still required after each batch. Over our total product mix, entry is required in about ten percent of the batches.

Concurrent with the evolution of polymerizer design and mechanized cleaning, we installed additional equipment to improve the removal of vinyl chloride from the reactor prior to entry. With our current multi-step procedure, we have reduced vinyl chloride levels in open polymerizers down to the ambient level in the buildings today. The worker is further protected from vinyl chloride release from PVC resin buildup by use of an air line supplied respirator during the cleaning operation.

In the late 1950's, we began the development and installation of larger reactors. These steps reduced worker exposure [illegible] and raw material attachments. [illegible] automatically reduce the [illegible] the amount of [illegible], and [illegible]. We now operate reactors [illegible] and [illegible] gallons.

[illegible] engineering and development effort has resulted in further scaling up of polymerizer size. By mid-1975 we will start up a new facility utilizing polymerizers of significantly larger size, which I will describe later on.

[illegible] the Louisville plant is an additional exposure to high levels of vinyl chloride because of infrequent entry into what we term "cold rooms." Basically, these were large, insulated, multi-story refrigerated rooms which housed equipment for the distillation and storage of vinyl chloride.

Operator activity in these rooms took ten to 1[illegible] minutes, once or twice a shift, but during these periods, exposure levels were up to 3,000 ppm. Today, entry is permitted only with an air supplied respirator.

The background of the Goodrich Louisville, Kentucky [illegible] problem was covered by Mr. [illegible]'s statement at the OSHA fact-finding on February [illegible], 1974.

At that time, we reported three deaths from angiosarcoma of the liver among Louisville plant workers. Since then, we have reported to Governmental agencies two additional deaths and two living cases of the disease, all at our Louisville plant.

After extensive and intensive epidemiological investigation of all of our monomer and PVC workers, no cases of angiosarcoma have been found in any other location.

Current programs to reduce levels of exposure -- all PVC plants in our manufacturing systems have achieved significant reductions in the level of vinyl chloride in the general work areas over recent months. This progress has been measured through the use of organic vapor analyzers, both portable and fixed, and based on literally hundreds of readings every day. The average of the readings has been reduced from about 35 to 40 ppm early this year to about 12 to 14 ppm today. These readings range from one to two ppm to some excursions over 50 ppm.

We are working hard to reduce the frequency of these excursions. During these excursions, or when there is a risk of such excursions, workers are required to wear air-supplied respiratory protection.

Included with this statement (Exhibit 2) is a summary of TWA exposure levels by job classification based on four-hour personnel monitoring techniques. This summary must be viewed as

preliminary since the jobs have only been monitored for a period of two months.

For example, we find considerable variation in TWA measurements ranging from below five ppm to 31 ppm on polymerizer charging operations.

Also included with this statement (Exhibit 3) is a six-months' history of area measurements of vinyl chloride levels by plants and by buildings showing the percentages of readings above 50 ppm and below ten ppm.

This improvement is the result of aggressive and comprehensive programs carried out in each of our PVC plants and in our VCM plant to identify and correct leaks, initiate operating improvements and emphasize increased employee communications. Here are some of the more important parts of these programs.

Leak reduction -- leak reduction has been the single greatest source of reduced vinyl chloride levels. The indispensable key to this progress was diligent monitoring on a 24-hour day, seven days per week basis to record concentrations of monomer and track down the exact source of each leak.

Early in January, personnel were assigned in each plant to do nothing but measure and record monomer concentrations and identify sources of the concentrations. Then, corrective action followed swiftly. OVA monitoring is still being done to locate sources of leaks.

Now, continuous recording fixed Bendix organic vapor analyzers are installed in all polymerization buildings in all plants. The Bendix instrument shows a higher reading if there is a significant leak anywhere in the area. The leak is tracked down with the portable OVA and repaired.

Operating improvements -- we have also made many operating improvements that have helped to reduce vinyl monomer concentrations in the work area. These include:

Vessels and pipelines containing monomer such as polymerizers, strainers, tank car unloading lines and Hamer blind installations, are being more thoroughly evacuated to recovery pumps before opening.

New procedures have been implemented for opening reactor manhole covers which reduce emission to the work area.

Regular vinyl monomer recovery operations have been improved and monomer efficiency raised.

Number of entries and time of each entry into polymerizer vessels for cleaning has been reduced.

Better manhole lid closure seals have been developed of polymerizers.

General ventilation has been greatly improved in many buildings. Localized ventilation has been installed at some repetitive trouble spots, such as pump seals.

Compressor and vacuum pump seal water have been put into closed systems.

Drainings from foam traps have been put into closed systems.

Some ventialtion and vent stacks have been put high above buildings so no monomer can be drawn back into the work area.

Tank car loading pipelines are vented and purged to flare before disconnecting.

Tank car sampling procedure is being refined for venting sample containers and purging to flare.

Employee communications -- Also important to the effectiveness of the overall program has been personnel motivation, awareness, training and dedication. Considerable time has been spent in every plant to develop 100 percent diligence in keeping concentrations of vinyl monomer in the work atmosphere low. Employee cooperation has been excellent.

Potential for further improvements -- further improvements can be expected from our work in the following areas:

A continuing investigation of better gaskets and seals.

Installation of special localized ventilation where determined necessary.

Better general push-pull, sweep-through ventilation is being installed where it does not already exist.

Continuing education and motivation improvement of the people.

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Further improvement of automatic systems to warn of excursions.

Installation of magnetic level indicators on our fleet of tank cars to replace dip-tubes which release monomer in the tank car loader work place. This will require 18 to 24 months to complete.

I mentioned earlier that we are constructing a new PVC facility at our Louisville plant, which will start up about mid-1975. This installation is a part of our continuing program to improve our PVC resin manufacturing system. Preliminary engineering of this plant was started in late 1972, funds were appropriated in July, 1973, and field construction work began early this year. It will employ large polymerizers, computer control, outdoor design and the latest technology. We expect vinyl chloride exposure levels to be lower than those currently existing in our PVC plants, but actual exposure levels will not be known until the fall of 1975.

We estimate that for the same capacity, a plant utilizing large reactors will have about 87 fewer potential fugitive leak sources compared with our smaller poly plants.

Although this new facility incorporates our latest technology, we fully expect to make additional improvements resulting from our on-going research and development work. It is expected that some of these improvements will take up to 24 months after the completion of the developmental effort.

Research and development -- Goodrich is doing everything it can with current technology, as rapidly as possible, to reduce vinyl chloride exposure levels. Further improvements and reductions in levels will come from the engineering changes and work practices we outlined previously. Improvements beyond these can only be achieved through future technological breakthroughs.

In the past five months, we have redirected and greatly accelerated our research and development efforts. We have 135 scientists and technicians at our research and development facilities and in our plants working on process and product improvements directed at lower vinyl chloride losses and reduced exposure. Our goal is to approach negligible losses of vinyl chloride from all sources.

About a quarter of the research and development effort is involved with analytical techniques and equipment, analyst training, and developmental analyses directed at worker exposure and residual monomer content of resins. During 1973, this effort resulted in selection of direct reading portable and sequential continuous monitoring equipment which have been essential tools in our efforts to reduce vinyl chloride levels in work areas of our production plants. Current effort is being directed toward more precise and rapid measurement of worker exposure.

About half of this research and development effort

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concerns fundamental process improvements to reduce losses inherent in our present processes.

To our knowledge, there is no PVC production plant in the world operating in a completely closed polymerizer mode because of the buildup problem in reactors.

Our programs toward this end include investigations of the fundamental mechanisms leading to resin adherence to polymerizer surfaces and a wide variety of methods aimed at eliminating adherence, chemically and/or mechanically. It is difficult to estimate how soon, if ever, we might achieve our goals in a practical way.

The balance of our research and development program includes reduction of monomer losses beyond the polymerization area. This is the development of a process by which the vinyl chloride monomer is removed from the PVC resin slurry before drying, thus increasing the recovery of vinyl chloride monomer.

This would also result in lower residual vinyl chloride in our finished resins when proven in production plant installations. We can foresee completion of this work and installation of facilities in two to four years for the majority of our resins.

Finally, in order to reach levels belowe .01 percent residual vinyl chloride in some PVC resins, we see the necessity for some basic changes in our manufacturing technology and the structure or PVC particles. This will take time to complete

the small-scale work and scale up to production facilities.

Goodrich position -- Goodrich believes it prudent to reduce levels of exposure to vinyl chloride, but opposes the proposed permanent standard for vinyl chloride. Achievement of no-detectable level of VCM exposure is not technically feasible. Neither is it feasible nor safe to require VCM and PVC workers to wear respiratory protection for fill eight hour work shigts. Thus, if the proposed standard is adopted, Goodrich would have no alternative but to shut down its monomer and PVC resin operations.

Goodrich generally supports the position outlined by witnesses for the Society of the Plastics Industry.

Exposure levels -- more specifically, we endorse the SPI proposal on the stepwise reduction of vinyl chloride levels in PVC work areas and in vinyl chloride monomer work areas.

Further, Goodrich is committed to reach these levels of exposure in the shortest practical time. As evidence of our commitment, before OSHA issued the proposed permanent standard, we set an internal goal of achieving a 25 ppm ceiling and 10 ppm TWA as soon as possible.

Monitoring -- the standard should require sequential monitoring of work areas in both monomer and polymer plants with proper alarms to signal the need for respiratory protection. This should be backed up with adequate personnal monitoring to validate the area monitoring system.

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contacted angiosarcoma ever passed out, or reported dizziness as a result of exposure to vinyl chloride?

MR. NELSON: Our records would indicate that they did not, or were not exposed to exposures of that level.

MR. KLINE: Do you know what percentage of your leaks are fugitive leaks?

MR. NELSON: No, there is no way of estimating any amount of fugitive leaks.

MR. KLINE: Are there leaks which are too small to be picked up by the OVA?

MR. NELSON: The OVA is a relatively sensitive instrument.

If the probe is placed close enough to the source of a leak you are going to get an indication of a leak.

MR. KLINE: Now, I take it that employees who clean vessels wear respirators, is that correct?

MR. NELSON: Yes.

MR. KLINE: And are they air line respirators?

MR. NELSON: Yes, they are.

MR. KLINE: I take it you have had no accidents as a result of the hoses, et cetera, or have you?

MR. NELSON: Not to my knowledge.

MR. KLINE: How long have employees been wearing air line respirators in cleaning the reactor?

MR. NELSON: Since early this year.

DR. LASSITER: That is, it will look at metabolic pathways, et cetera?

DR. [illegible]: Yes, using labor materials.

DR. LASSITER: Do you envision that any of the test that you have, that you are talking about here, would be useful in early warning type situations with workers who might be exposed to vinyl chloride?

DR. [illegible]: Yes, I do.

I think, particularly, the liver and to general stud[illegible] and possibly the sinus blood flow of the functions.

DR. LASSITER: Would these be early enough to realize abnormalities, even including false policies prior to malignancies developing in the liver?

DR. [illegible]: I certainly would hope so, yes, indeed.

MR. [illegible]: I have one further question.

Mr. Nelson, on Exhibit 2, you have indicated that you require the wearing of a respirator at 25ppm, or when there is a risk of exceeding 25 ppm.

Why do you do that?

MR. NELSON: It is just consistent with our internal goal of reaching a 25 maximum ppm ceiling, and we are requiring respiratory protection, when the exposure does or could exceed 25 ppm to your standard --

MR. [illegible]: What kind of respirators are these employees wearing?

MR. NELSON: Those are cartridge type respirators, just used for brief exposures. Air fed respirators at about 25.

MR. KLINE: If the exposures -- I am sorry, I am not sure I heard you.

If the exposure is above 25?

MR. NELSON: Above 50. Air fed respirators.

DR. LASSITER: I have one more for Dr. Moore.

Much speculation is centered around the geographical distribution of the angiosarcoma deaths with the vinyl polychloride workers.

Do you have an opinion as to why more cases have occurred around the Louisville facility than have occurred elsewhere?

DR. MOORE: I just have to rely on what I was told by Dr. Creech, who has been connected with the Louisville plant, that it is the oldest of the plants, that it is still using the original technology, more or less, that was used about 1940.

The two cases that were reported in Connecticut, where the workers were not directly exposed but they were simply working in the vicinity of the plants, are [illegible] puzzling, don't fit with the concentration that we have with the level -- I mean, if the concentration level [illegible] [illegible] of angiosarcoma cases was due to very, very high [illegible]

MR. BECKER: I would object to that. I don't see where it establishes the standard.

MR. SAMUELS: I would be happy to answer the [illegible] of the question.

The industry, sir, has introduced the importance of economic feasibility and over our objections. By the way, we are trying to grapple with the problem of economic feasibility which might be done on an economic basis and these questions that I am asking refer to the micro level.

You have a new plant going in.

I think it is important to know what the plant cost, and what percentage of the total outlay is being spent on vinyl chloride containment.

MR. JOHNSON: Gee, we have not raised the economic feasibility question in this hearing, and it is simply an irrelevant question.

JUDGE WYATT: All right, we won't debate it.

Mr. Samuels, I am going to sustain the objection to it and not compel him to give you an answer.

MR. SAMUELS: Are you ruling that economic feasibility --

JUDGE WYATT: I am not ruling on economic feasibility. I am simply saying that particular question. They do not need to supply you with the answer as to what percentage of the outlay, the cost of the plant is and what the cost of

data that is necessary.

Now, he introduced this into the record, a quote from Arthur D. Little study on behalf of the environmental protection agency in which they use in their indices the cost per pound, and I am trying to establish this through comparable data, and I find it very difficult to do that.

JUDGE MYATT: All right. I am going to overrule the objection. If you can give him the range.

MR. VITTONE: The range of prices is in the order of 20 cents per pound to 35 cents per pound.

MR. SAMUELS: Dr. Moore, do you have any idea about the actual cost to your medical center per case that you have handled?

I understand that you have handled most of those, if not all of those, that come in.

DR. MOORE: No, Mr. Samuels, that is not quite correct. Though the majority of those patients, that is the patients who were actually sick, were managed at St. Anthony's Hospital by Dr. Creech and the staff there, before our input began, one patient was managed, since we have been closely connected and working the program out mutually; but, there again, it was at a private hospital.

MR. SAMUELS: I see. Would you have any -- even if you didn't handle it directly, have any idea what these costs might be?

you gave the delivery time of your new reactors as 16 to 18 months. Can I assume that these were ordered some time ago?

MR. NELSON: Yes, they were ordered about the third quarter of last year.

MR. BAUER: Do you have any idea what the delivery would be for equipment ordered now or in the next, maybe, six months?

MR. NELSON: At least 18 months, perhaps as long as 24 months.

MR. BAUER: Thank you, sir, that is all I have.

JUDGE MYATT: Mr. Hechman?

MR. HECHMAN: Jerome H. Hechman, General Counsel, Society of the Plastics Industry.

Mr. Vittone, I just want to be clear on B.F. Goodrich's position and, in the sense, also SPI's, and you are in a position to answer for both.

Is it not your position that the B.F. Goodrich is spending what it is spending on improving the containment situation within the limits of technical feasibility and without regard for whether or not there will be savings on such matters as workmen's compensation and that type of thing?

MR. VITTONE: That is correct. As I stated earlier, we do not claim economic feasibility. If we have the feasibility for doing it, we are doing it.

MR. HECHMAN: Are you doing everything you can do

within your technical capabilities?

MR. VITRONE: That is correct.

MR. HECKMAN: Is it your understanding also that the EPA position with respect to economic feasibility is that a [illegible] should not be set that would put the industry out of business and, thereby, would create greater economic impact throughout the economy?

MR. VITRONE: That is correct.

MR. HECKMAN: And that is the basis of the economic position?

MR. VITRONE: That is correct.

MR. HECKMAN: Thank you.

JUDGE KYATT: Are there any other questions from the floor?

(No response.)

JUDGE KYATT: All right, gentlemen, thank you, very much.

By my watch, it is five after 12:00.

We will adjourn for lunch until 1:30.

(Whereupon, at 12:05 o'clock, p.m., the hearing was recessed for luncheon, to reconvene at 1:30 o'clock, p.m., the same day.)

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the Administrative Law Judge a set of documents expressing in detail the data, views and arguments of J-M which we request be incorporated as part of the official record of the proceedings on this proposed rulemaking.

Johns-Manville recognizes the need for, and is dedicated to, the protection of the health of its employees and believes it has a [illegible] obligation in this regard. This is the premise upon which we are proceeding.

Regardless of the permanent standard for vinyl chloride ultimately promulgated by OSHA, J-M will make the best possible effort to reduce vinyl chloride levels at its plants to the lowest extent feasible, in addition to complying [illegible]

[illegible]

proposed permanent standard, as published in the Federal Register, is not necessary nor is it appropriate for PVC pipe and pipe fitting manufacturing operations. J-M's concern is not with the numerical exposure level proposed by OSHA, but with many of the administrative and work practice requirements contained in OSHA's proposal.

Our reason for supporting this conclusion is based on the fact that in most work areas in our PVC pipe and pipe fitting manufacturing operations, where employees are regularly assigned on a sustained basis, the levels of vinyl chloride monomer are well below one ppm, the OSHA proposed "detectable

Thank you very much.

JUDGE MYATT: All right, gentlemen.

Thank you.

Mr. Kuchenbecker?

MR. KUCHENBECKER: Thank you very much for the suggestionsand recommendations.

I would like, however, to address a few questions to you.

On page 2 of your testimony you stated that there is insufficient medical evidence to indicate human health problems of vinyl chloride that would be typical in the operations of a PV processor or fabricator.

Do your have any testimony to establish what a safe level would be?

MR. MILLER: What page?

DR. HARRIS: Page 2.

What was your question again?

MR. KUCHENBECKER: Concerning the scope and application.

DR. HARRIS: What do you want?

JUDGE MYATT: He wants the question repeated.

MR. KUCHENBECKER: Do you have any evidence to establish what a safe level would be for human exposure in a PVC or PBC plant?

DR. HARRIS: I don't believe that we have the means

right at the moment to be sure.

I suppose you won't have the means for a number of years.

The only thing we can go on really is the human data and we have the nineteen known cases but they are not really enough unfortunately.

Unfortunately we don't know what those levels were in the early years.

They must have been very high.

I think we are a little bit in the no-man's land. We can't get as clear an a swer as we would like to it.

MR. KUCHENBECKER: Could you give us any idea of what would be the necessary amount of evidence so that we could form a conclusion on this?

DR. HARRIS: Well, I am sure experts will differ a great deal depending on their expertise.

I really don't suppose that I am really qualified to answer that definitively.

MR. KUCHENBECKER: Is anyone on your panel addressing themselves to that question?

DR. HARRIS: Not definitively, no.

MR. KUCHENBECKER: On page 3 right at the end of the second paragraph you talk about risk categories.

I am a little unclear as to what you mean by that.

Can you explain that for us?

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MR. MILLER: No.

MR. KUCHENBECKER: Thank you.

DR. LASSITER: I have just two brief ones, mainly for clarification.

Do I understand the RMA position regarding the health hazard of vinyl chloride both from what was presented in your testimony in written form and what has been said orally concerning the human cases that the RMA just considers vinyl chloride to produce angiosarcoma of the liver both in animals and in humans, is this correct?

DR. HARRIS: I think that is correct.

Certainly, we know that in the animal studies it has and in the humans there is no question, at least in two or three plants, and the real puzzle is as to why some not others, whether there might be some complicating factors.

I personally would have to agree that it would appear that it probably does cause angiosarcoma under extreme conditions.

DR. LASSITER: Well, we were talking about the animal studies -- I suppose I should have mentioned Maltoni.

How about his work?

Do you believe the animals in his study did get angiosarcoma of the liver?

DR. HARRIS: I would consider Maltoni's work exquisite.

I think that I have seen it. It is some of the finest work that I have ever seen anywhere and he is thoroughly knowledgeable about the animal end of it and the material he used was unquestionably vinyl chloride, so I could only conclude it is good work and pretty much says what he says it does.

DR. LASSITER: Okay, the reason I asked that last one, you made a statement in your presentation in which you said two out of two hundred mice contacted angiosarcoma of the liver and we fail to see how OSHA can conclude that exposure to vinyl chloride of fifty parts per million can seriously pose a health hazard to humans.

I realize there may be some conjecture about the no detectable level on your part but I am concerned about the serious health hazard to humans.

Is this a correct conclusion?

DR. HARRIS: I guess I shall take that one, too.

I didn't write it but I can't particularly argue with it.

The point is that animal data is helpful. It indicates a possible problem. It doesn't prove anything.

Animals and species of animals can easily vary a thousandfold on some chemistry, that is the amount it takes to produce a toxic effect.

That is not the usual situation.

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Often a chemical will possess one or more properties which present a hazard to human health or safety, such as explosiveness, corrosivity, toxicity, flammability, or carcinogenicity.

However, carcinoginicity presents a special problem in establishing controls because the minimum amount required to induce effects in humans if generally not known, and there frequently is a long induction period between exposure and effect.

The American Chemical Society has carefully reviewed the most recent information on the subject of vinyl chloride and polyvinyl chloride which contains variable amounts of unreacted vinyl chloride in occupational exposures and the suspected relationship of vinyl chloride to angiosarcomas in humans.

In the general population, angiosarcoma is a rare carcinogenic lesion. Vinyl chloride has been found to induce angiosarcomas of the liver in mice at exposure levels as low as 50 ppm which a period of six months and as low as 250 ppm in rats within a period of two years.

This information on experimental animals, when considered in relation to the discovery of the same rare angiosarcomas of the liver in humans who had been exposed to vinyl chloride, probably at high levels over a period of years, strongly suggests a cause and effect relationship

ok6 between vinyl chloride exposure and the appearance of the angiosarcomas in humans. There also appear to be indications that vinyl chloride is a carcinogen for sites other than liver, but epidemiological studies are necessary to confirm these preliminary findings.

What remains in question is the actual minimum level of exposure to vinyl chloride which may induce angiosarcomas in humans. While some chemical carcinogens have indeed been found to have an apparent threshold value, the Society recognizes that there are no scientific data currently available to set conclusively a threshold limit for safe exposure of humans to vinyl chloride.

The Society recommends continuing experimentation to define a threshold value for carcinogenicity of vinyl chloride, both for sustained and for intermittent exposure, and periodic review of the standard in light of new data that indicates or defines this value.

The Society recommends similar investigations for any possible carcinogenic effects from associated contaminants in vinyl chloride. Structural analogs to vinyl chloride should be investigated for carcinogenic effects as well.

In the absence of data establishing a safe level of exposure to vinyl chloride and in the interests of public health and welfare, the Society endorses the proposed standard for the level of employee exposure.

However, the Society believes that the standard for

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These numbers were accumulated as a result of a sudden new interest that developed.

I have a feeling many factors were involved and that, you know, I think anybody that looks into the biology of the human system can put their fingers on many possible variables.

MR. TOPOL: Okay. Following that up if we can, is it one possible explanation the fact that exposure levels in the plants which had employee cases with higher than exposure levels and the other plants and that the higher exposure levels were the cause?

MR. FAWCETT: Undoubtedly it could be a factor, yes.

MR. TOPOL: And then if you sort of pursue this, wouldn't it be possible that if we knew the exposure levels in the plant in which there were no cases, we could reach the conclusion that those levels of exposure were safe levels, that is, they were below the threshold that you talked about?

MR. FAWCETT: Well, you are now extending your logic in an illogical manner. Because when one applies that kind of logic to the human systems, one is in trouble, particularly when the induction period is five, ten, 15, 20 years.

There is too many variables in a lifetime. I have had some pretty severe traumas and severe exposures to an awful lot of chemicals and an awful lot of things in a lifetime.

I am curious to see my own death certificate because I am curious to see what I died of, because it could be a

number of things, all of which could be perfectly justified but I don't know.

I think to follow the kind of logic that your mind is taking too at the moment, is going to lead you to erroneous conclusions.

MR. TOPOL: Well, my question to you is, once you postulate the fact there might be threshold levels, say, threshold for this chemical exposure, isn't it possible that the reason that there were no cases at a number of plants is because levels did not exceed that threshold?

I mean, I realize that we can't say for certain.

MR. FAWCETT: That is one possibility, yes.

MR. TOPOL: Let me follow that one step further and tell you that we have had -- let me ask you, we have had testimony from the Dow people who did a complete survey on all their employees and concluded that they found increased malignancies among employees exposed for long periods above 200 ppm and no increased malignancy, indeed decreased malignancies for employees exposed below 200 ppm.

How would that relate to what we are talking about? Wouldn't that tend to confirm the threshold thing that you and I have been discussing?

MR. FAWCETT: Yes, 20 years from now chances are you can come to such conclusion.

It is the induction period that makes it so

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pernicious. Something catches on fire -- that is immediate, you don't spend time speculating about 20 years later.

MR. TOPOL: When you say this induction period what are you talking about, 10 or 20 years or what?

MR. FAWCETT: These are the degrees of magnitude that people talk about and it is not unique to this material. It is unique to any material that causes any of these disorders. Alveolarosis, where people have been exposed and then 20 year or even 25 years later were found to have alveolarosis.

So there is all sorts of long term effects that will be long, that will be occurring long after you and I have talked about this subject.

MR. TOPOL: But in the case of the Dow testimony, the Dow testimony was that their plants started in 1946 and that they did determine employees exposed over long periods of time, so that would cure that particular defect.

MR. FAWCETT: All right.

MR. TOPOL: Let me ask you a related point. You indicated or I think Dr. Quigley did, in the direct testimony, that the Society endorsed research, I think having to do with chemical compounds associated to vinyl chloride, isn't that correct?

I didn't have the testimony. I want to paraphrase it accurately.

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Is that Dr. Quigley, accurate?

MR. FAWCETT: Chemical analogs.

MR. TOPOL: Could you explain in detail why it is you want to test, why it is you want to test the chemical analogs, what the point of that is?

DR. QUIGLEY: Well, I think that when you are concerned about the hazardous effect of any chemical that when you consider the analogs of any structure that is hazardous, you want to find out what possible hazards there are in the analogs that might be similar and so it is a natural tendency for research chemists of investigate the analogs of any compound.

MR. TOPOL: Do you also endorse testing the other compounds to which employees of vinyl chloride operations might have been exposed at the same time that they were exposed to vinyl chloride, is that implicit in your statement?

I am asking it. I didn't understand it.

DR. QUIGLEY: Right, the statement says specifically the Society recommends similar investigations for any possible carcenogenic effect from associated contaminants for vinyl chloride and then to extend that, I think it would be a fair inference that we would and have historically been in favor of investigating the safety aspect of all chemicals and all compounds and all materials that people working in chemical plants have to deal with.

MR. TOPOL: Does this relate back to the earlier point we had in the colloquy that perhaps the fact that employees exposed to vinyl chloride were also exposed to a second chemical that it is this combination of chemicals, the so-called synogistic effect that produces the angiosarcoma?

Would that be the point of research to see if that occurs?

DR. QUIGLEY: I think it is a supposition and I don't think we are qualified to answer that at this particular point in time.

MR. TOPOL: That is the subject that needs research, I gather, from your testimony?

DR. QUIGLEY: I think so, yes.

MR. TOPOL: What final area briefly, please.

Did I understand your testimony to be that you have concluded that the proposed, that the level in the proposed standard could be feasibly attained in current facilities if a sufficient time were provided for engineering changes, is that the essence of your testimony?

DR. QUIGLEY: Yes, sir.

MR. TOPOL: Okay. What do you base your conclusion on that the proposed standard, even with time, with assuming now unlimited time if you would, assuming unlimited time, what is the basis for your conclusion that the level of the proposed standard can be technically attained?

engineering design difficulties in applying those types of instrumentation to the particular environment in which the workers are operating, is another problem.

MR. TOPOL: Okay --

DR. QUIGLEY: And that needs work and research and development.

MR. TOPOL: Okay. I want to move away from the instrumentation design.

That is the question. Can you design equipment to detect very, very small levels? Now leaving that to one side, my question though is;

What is your basis for concluding or maybe you haven't concluded that the industry can get the very low levels that are proposed in the standard?

In other words, that they can make the engineering changes to essentially get to a work environment that has those levels of exposure.

Do you have any basis for concluding that that is technologically feasible given unlimited time?

DR. QUIGLEY: Other than as I stated before, all of these ramifications of the problem were discussed at some length and in some depth by the participants in the deliberation and they in their professional experience, which includes a great deal of industrial experience, reached the conclusion that it is technically feasible to reach this level of

ek41 standard.

MR. TOPOL: Okay. Would you submit -- two questions. First, was there any data assembled for purposes of reaching that conclusion other than these gentlemen's views?

DR. QUIGLEY: As I stated before, sir, there were no lengthy studies conducted by the Society.

The Society draws on the experience and the resources of the experts among its membership to make these recommendations and so whatever data, individuals who are involved had after exposure, whatever experience they had in these areas, was applied to this problem at that particular time.

MR. TOPOL: Were any of these individuals employed by or representing polyvinyl chloride manufacturers?

MR. FAWCETT: Yes.

DR. QUIGLEY: Yes, sir.

MR. TOPOL: Who were those individuals?

MR. FAWCETT: Should we specify names?

DR. QUIGLEY: Well, I think there is no reason why the list of all the individuals of the committee can't be involved because they are a matter of public record.

MR. TOPOL: Would you make available along with the names, the committee members, the meetings where this subject is discussed or the portion where it relates to this subject

of this nature over long periods of time?

DR. QUIGLEY: I have to defer that question to Mr. Fawcett.

MR. FAWCETT: The committee per se probably has limited data on it.

I personally have had a considerable amount of experience on this subject. A great deal of confusion and this goes back 20, 25 years now, not in the past couple weeks, for example, 15 years ago a very well known chemical company produced a motion picture training film to educate its employees on how to use the kind of clothing that we are talking about.

It seems long since forgotten and even OSHA doesn't know about it. This film is still available, it was made from a major chemical company. The concept here is that people could work for long periods of time if you had the right kind of air flow, not just to the hood, not just to the breathing zone, but also in various distribution media, down to other parts of the the skin.

These air supplied suits are in fact possible where for long periods of time they certainly were designed for exactly the kind of thing that the reactor autocally polymerization cleaning type thing. Because they were designed for different chemicals but incidently they were designed for chemical carcinogens long before vinyl chloride came down the road.

I would suggest, sir, that you get a copy of a book called Safety and Accident Prevention, Chemical Operations and read chapter 33, because I wrote that chapter over ten years ago and I still feel very strongly and you will find it on page 373 to 428 and I think if you look at that critically, you will find that there is a tremendous wealth of knowledge here that nobody has ever wanted to admit existed.

I put it in there and very carefully documented what is in there and I wouldn't rewrite more than a couple of sentences in that 56 pages, if I would rewrite it today.

The simple fact of the matter is people don't want the equipment because it is trouble and it costs money. We understand that it is trouble and it costs money. But I am a worker, I can assure you I don't just sit on platforms all the time.

I have got my hands dirty. I have been in chemical things that contain chemicals and in actual fact this equipment can be used if people are educated to use it and know the advantages and the necessity for using it.

MR. BECKER: And over long periods of time?

MR. FAWCETT: Over long periods of time. As long as you want.

This specific training film I am talking about talks about 8 hours. I don't know how much overtime you can afford to pay your employees, but most employees don't work

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over eight hours a day.

MR. BECKER: Thank you.

JUDGE MYATT: Any other questions?

MR. KLINE: Your Honor, if I might make a request, would you mind making that article available to the Department of Labor in posthearing conference?

MR. FAWCETT: The article is in a book. The book can be purchased from the Tom Wylie Company in New York City and the exact title of it for the record, Safety and Accident Prevention in Chemical Operations by Fawcett and Wood, W-o-o-d is the second name, Wood, published by Inter-Science Division, John Wylie & Company, 1965, Chapter 23, pages 373 to 428.

That is the exact citation, sir, and I frankly don't have a copy at the moment to give you because I have given them all away to other worthy charities that came down the road a long time ago.

JUDGE MYATT: Are there any other questions?

MR. STEELE: Arthur B. Steele, Union Carbide.

Doctor, I have been a member of the American Chemical Society for 35 years and worked in this industry for more than 30 years.

Would I qualify as one of those membership resources to which you constantly refer?

DR. QUIGLEY: Yes, sir, I would hope so.

our fellow trade unionists to destroy the economic base of our existence, that being the jobs of our dues-paying union membership. Our purpose here today is to urge the adoption, with minor alteration, of the reasonable proposed permanent standard on vinyl chloride.

Anything less would be to continue the subsidy being given by American workers of years of their lives to produce vinyl chloride.

OCAW is extremely concerned about the vinyl chloride problem. Data has been developed by Dr. Irving Selikoff of Mount Sinai School of Medicine through examinations of the membership of Local 8-277 of the Oil, Chemical & Atomic Workers, who are employees of the Goodyear Tire and Rubber Company in Niagara Falls, New York.

Dr. Selikoff's medical team found a significant prevalance of liver abnormalities, peripheral vascular changes, and lung abnormalities. Acroosteolysis was also found. The Mount Sinai mortality study also found an excessive number of deaths, an excessive amount of cancer, and as well as 23 percent of the United States reported industrial angiosarcomas among this group. These data indicate to us that a serious problem exists and is in need of serious immediate attention.

What further disturbs us is that the problem of vinyl chloride abnormalities was known to some elements of the scientific-medical-industrial community for some years, but

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it was not until the Goodrich episode did people who work with the substance and their designated representatives were made aware of the problem.

It may be helpful, as we are testifying in the latter half of this hearing, to put some of the testimony thus far into perspective.

The vinyl chloride industry is divided into three parts: monomer production, polymerization, and fabrication. the OCAW represents thousands of workers among all three parts. Industry testimony has indicated that each segment has its particular problems.

Industry has proposed that the fabrication segment essentially be exempted from the proposed standard. We oppose this. The testimony of Robintech, Goodyear, Diamond Shamrock, Goodrich and others as well as NIOSH indicate that there is detectable exposure among some stages of the fabrication process. However, there is general agreement that known engineering solutions such as ventilatior and reduction of the residual monomer in the polymer will reduce exposure to the nondetectable level. We encourage all efforts in this direction. However, these improvements would rot have come about had fabrication plants not been included under the emergency temporary standard and the proposed permanent standard.

We therefore request that fabrication firms be

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MR. MAZZOCCHI: We have a statement of Vern Jensen of the Union Carbide Local which we will present to you after his presentation.

MR. JENSEN: As Mr. Mazzocchi indicated, I am Vern Jensen, President of Local 891, New York, Union Carbide Company, which fabricates vinyl chloride into sheeting and film for a variety of purposes.

I have worked at the plant for 27 years.

For upwards of 20 of those years I worked in a place called Building 101, where we, by much more primitive means than we are using now, made polyvinyl chloride into film and sheeting, and at that time various granular products for coating, and things of that sort.

It is exceedingly disturbing to me that we worked for all of those years with a substance that we thought was totally inoccuous. No one ever disavowed us of this notion, and it seems to me that at a minimum, someone in our industry should have been sensitive and aware to what experimental findings were going on elsewhere in the world, and that we should have been informed in some manner that we were incurring some degree of hazard, that someone should have been concerned.

Since that time we went into a much more modern facility, Building 105, a separate division, fibers and fabrications, and most of the fabrication of polyvinyl chloride is now down there.

Since the Goodrich case Union Carbide has undertaken a sampling program. We have a plant hygienist now, which we didn't have before, but now that we have a plant hygienist and he has taken samplings throughout the plant, actually we have heard about the rules being set forth guarding the sheep.

In this particular case we have had OSHA take follow-up readings.

I do not have any reason, in all honesty, to doubt the accuracy of the readings that were taken, but we can't, in good consciousness to our people take these things as an article of faith, because they are not exactly impartial findings.

They will certainly be a detriment to the company if the findings were too high, so we have got, or OSHA will do a follow-up check.

We don't have the figures as yet, but we do find that we have a formidable amount of vinyl chloride exposure in the fabrication end of polyvinyl chloride.

The highest exposure readings were got in the van boxes. We get some material from Texas City primarily, and apparently there is a good bit of free monomer in this material, because in the van boxes it gets as high as 7,500 to 9,000 parts per million.

Of course, nobody is going into the van boxes. The readings obtained for the gentleman who does the sampling from the van boxes, who makes the hookups to get the resin into the

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operating facilities was exposed by Union Carbide readings to two parts per million.

The [illegible] exposures we found, where the men who actually exposed to the material, or closer to it, was a fred blending operation.

Here, some were found to be four parts per million. Of course, no one sticks his head in a pre-blender in sampling resin, but they come close to doing so.

We have found exposures as high as 175 parts per million among people who sample the polyvinyl chloride for pre-blend, for lab testing.

The average weighted readings in that area were seven parts per million, but the people in sampling and cleaning those blenders are exposed to considerably more.

Now, management has taken steps at this point to make that situation better. They have introduced a new sampling technique before they make the engineering changes, before they take place, of having the people wait for a specified period of time before taking a sample, and then take the sample with a long handled scoop.

The readings have been materially reduced by so doing to the order of 2.8, something in that area, parts per million, among the people doing the sampling.

Nevertheless, the possibility for a great deal of exposure to polyvinyl chloride gas is certainly present there

coming off the pre-blender.

Another source of concern in that particular area, and one which has not been adequately explored, we feel, has been that tremendous presence of polyvinyl chloride dust, which may or may [illegible] be harmless.

We almost swam in this stuff during the period we thought it was without any harmful effects.

We have had a continuing fight with management, and which the situation has gotten better in recent months, admittedly, over the high levels of dust, the exposure on the pre-blending floor in Building 105, and we wonder whether inadvertent concentrations of dust might be harmful.

We have had the OSHA out there, and I believe at this juncture the PVL dust is called a nuisance dust rather than a non-harmful agent outside of an irritant, but it may be it is, and I would hope that research is undertaken in this regard also.

Now, management has projected engineering changes up there to lower that level of exposure of seven parts per million.

It should lower it, and to me, to well below the limit that no detectable amount projected by OSHA, because with poor ventilation there, without really good ventilation from the pre-blender we have still gotten down to seven parts per million.

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It would be very hard for me to understand why it would not be feasible to meet the much more stringent projected standard.

In the calendar operation this material goes through an extruder, where people don't come into contact with it, although quite a considerable portion is vented out into the air for the discomfort of our neighbors, but when we got to the calendar operation this was a source of concern to me because it seems to me where most of the people back through the years have gotten heavy exposures.

We have found exposures of two parts per million at the maximum point where fumes are coming off and going up in the venting system, and very few people have to be anywhere near to be in contact with the fumes at that point.

We have in other parts of the plant this earlier production facility where the methods of production are a bit more primitive.

We saw a fairly good blending here where we are down to like .2, .3, .4 parts per million there, so it would seem to me certainly that at the location, at the projected Federal standard, it is certainly within the engineering capabilities.

I think that probably won't be there as soon as they have made the changes on the pre-blenders, and as in a few other places.

From my many years of Union activity, and that goes back to about 1960, with one short interlude of being back in the regular laboratory work, I found that people in management, as in labor, are just about as good as they have to be, and they need rules and regulations to do what they should do.

My many years of acquaintance with Union Carbide, and bargaining with them, has convinced me that no matter how enlightened the management might be, if we have good management at the plant, managers change just as Union officials do, and the best way that moral persuasion on the part of the Union, and argumentation on the part of a Union has never been effective as Government regulations.

Witness the sudden appearance of an industrial hygienist at the plant, which was post-OSHA, and had nothing to do with our earlier arguments about industrial health, which we made many of.

I strongly support the international position, and urge the adoption of the standard proposed.

JUDGE WYATT: Does that conclude it?

MR. MAZZOCCHI: Yes.

MR. KUCHENBECKER: Mr. Mazzocchi, I have a few questions for you.

On page two of your testimony, I don't know what paragraph it is, it is down I think, the second to the last paragraph, you state there is general agreement that no

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MR. WODKA: Well, we talk about known engineering solutions.

Again, we were taking from their testimony which they talked about increased ventilation, and things like this.

MR. KUCHENBECKER: All right, on the last paragraph of that page, the first sentence, you talk about the monomer plants, and you say they will also have little difficulty reaching a non-detectable level.

In this a similar conclusion you have drawn?

MR. WODKA: Well, this is a different kind of situation in the monomer plants. They are different kinds of facilities.

In the monomer plants they run like oil refineries, the big petrol parts of our large petrol chemical facilities, and we have detailed on the top of page three the areas where exposure occurs, and this also concurs with the NIOSH testimony. Those are leaking equipment, tank car loading, and unloading, quality control sampling, and maintenance operations.

Now, possibly in the latter three there are approved procedures that can be used, but in the last analysis, particularly, let us say maintenance operations, our people probably will have to always wear personnel protective equipment.

However, in the key one that the industry talks about, is leaky equipment, how can they control their equipment that is chronically leaking?

Our experience in studying industry this many years is that there is no preventive maintenance program in the petrol chemical industry as well as petrol industry.

In other words, equipment is run until it starts to leak, until it starts to fall apart, and if these companies would spend the money and have proper programs, and move equipment, or bring or take it down for maintenance before the leaks occur, then this other problem they have mentioned as a very big one would not be a problem any more.

MR. KUCHENBECKER: Is this an example of what you cited as improved procedures?

MR. WODKA: When I say improved procedures, possibly, let us say, for maintenance.

There are things for decontamination wherever that could occur, tank car loading, and unloading.

I have here procedures where you reduce the amount of vinyl chloride that is released during this kind of operation.

MR. KUCHENBECKER: Do you have any data to show what the effects of those improved procedures are?

MR. WODKA: No. What we are doing here here is relying on two things.

Number one is the testimony of NIOSH, presented to you, and number two is evidence given to us by our monomer plants, our local 4-347 that is at Deer Park, Texas.

MR. KUCHENBECKER: The next sentence, the beginning of the second paragraph, you say that the chronic exposure from leaking equipment can be cured by better engineering.

What do you conceptualize as chronic exposure?

What amounts of vinyl chloride and ppm do you envision?

MR. WODKA: We envision the reduction to --

MR. KUCHENBECKER: Well, the chronic exposure from leaking equipment.

MR. WODKA: What are these levels right now?

MR. KUCHENBECKER: Right.

MR. WODKA: Well, we are assuming that what the industry is saying right now, that there are exposures somewhere around ten or 15 parts per million, are correct.

Let us take that assumption and say that is correct. We are saying that much of that exposure is occurring from leaking equipment, and that is our chronic exposure. That is the maintenance operation which is a more intimate kind of nature.

Now, you talk about better engineering. We are talking about seals, and packings, and pumps, and whatever are better engineered to better hold up under these processes.

Possibly they will be more expensive.

MR. KUCHENBECKER: Down in the third paragraph on page three you state that you have yet to see conclusive

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evidence.

Could you give me any idea of what you would consider as conclusive evidence?

MR. WODKA: Well, when we say conclusive evidence, we heard a lot of talk here, a lot of testimony, that the levels are too high, that the levels in the polymerization of plants cannot meet the known technical level.

Now, what we are seeing I think is a situation where the industry is taking peak exposure, or excursions, and is saying that because of these types of exposures we can never meet non-detectable.

On the contrary, we feel that, as we argued with the Goodyear plant in Niagara Falls, here is an old plant, possibly the worst kind of plant. There were three angiosarcomas in this plant.

Why is it this plant can get down already to 11 parts per million?

We have to break it up between average exposures and excursions.

On the average we feel that polymerization plants, based on our experience with the Goodyear plants, can come down to a non-detectable level.

I think we gave you figures here of May 21 to May 28, that the average was the level.

The figures for June 25 to July 2 are eight parts

per million, so it came down in a few weeks, down to eight parts per million, on the average.

We feel that, and this is again from direct eviden from our people in the plant, that constantly improved engineering and operating procedures on the part of our people are bringing the levels down.

Okay, so that is your averages.

Now, the other part is your excursions.

It is our opinion that reactor cleaning, the actual sending of the man into the reactor possibly will never be a non-detectable exposure, and you always have to have a guide in the casing, so to speak, when he goes in and cleans the reactor.

I think we have to be realistic, and realize that that is always going to be a space suit operation.

The other part of it is that there will always be, when you are working with large amounts of vinyl chloride, it is always possible, say something breaks open, now we don't wa to hid ourselves, but these things can happen.

You know, we tell the industry that we want our people to be prepared, and to be trained for how to deal with these kinds of occurrences.

For instance, Air Products Company has proposed a monitoring system tied into an alarm. We think that is fine. We think that an alarm, that an alarm would merely go off, and

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(4)

once it goes above I presume the non-detectable level people would gather the proper kind of protective equipment.

MR. MAZZOCCHI: I think the Goodyear situation is very important, because here is a plant that was never monitored, knew nothing about, or ostensibly knew nothing about the problem of vinyl chloride.

The the Union arranged the examination for the employees.

Examinations were conducted. You are all aware of Dr. Selikoff's findings that have been introduced in the evidence.

We met with the company. The company, we acting as a catalyst, the company got moving and accomplished a great deal very rapidly.

The numbers are dramatic. We didn't know what the numbers were before, but based on the lack of real engineering controls prior to the Goodrich episode, when people at Goodyear were making really no effort to control it, we see dramatic progress.

There is no question in our mind, taking this particular facility, which is old, and has many problems, that they have been able to get these levels down to where they have substantial evidence, in our opinion, that it can be done.

MR. KUCHENBECKER: All right, you stated that you have reviewed the monitoring data from the Goodyear Tire and

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Rubber plant.

Have you been able to review data from any other PVC plant?

MR. MAZZOCCHI: Goodyear has been providing the Local union in a very formal way.

At the present moment we don't know of other Local who received it in the formal statement.

Vern, does your Local receive it as a formal presentation?

MR. JENSEN: It is not part of our contract.

I meant to mention this in my presentation earlier I do think that it is a good thing that we have got a health and safety clause, which I do think would be most helpful in protecting us in the future, the part of that is that one representative of the union would receive any of the company monitoring in terms of actual numbers upon demand, not a go or no go, or good or bad. We will get the actual numbers.

MR. MAZZOCCHI: Again, this has to be viewed within the context of what the experience was up to the Goodrich episode.

Companies do not provide us with any monitoring information.

In fact, there are very, very few companies who monitor at all for a whole host of substances.

Monitoring is known by its absence, rather than

by its practice.

Secondly, we have the problem of even having the substances identified by the generic name that we work with.

You know, we have come from a situation of class ignorance about many of these substances we work with to divulging the substances we work with, and also some of the associated trauma with that particular substance.

For the first time we are seeing some numbers.

MR. KUCHENBECKER: On the top of page four you state your desire that those plants that can meet the non-detectable exposure limit be required to meet it.

I take it that for all those plants you suggest the various procedures be followed.

MR. MAZZOCCHI: Yes, sir, precisely. The Act foresaw the situation. It provides a mechanism that cannot legitimately meet that standard, but we then have a mechanism which each company can come forward and say this is our problem, there is a hearing around it, the employees can test and agree with it if they wish.

If the problem exists, there is a remedy for the problem. It is is not carte blanche approval for the industry to have to have an easy gove.

MR. KUCHENBECKER: Down at the bottom of the page you have listed some specific suggestions section by section.

In the section dealing with medical surveillance,

and part (3) on the third paragraph, part (9), you suggested the medical records should be kept for the workers' lifetime.

Do you mean all workers, no matter what the life of their exposure to vinyl chloride?

MR. MAZZOCCHI: Precisely. There is no evidence that we can accept that associates time with carcinoma.

I think I have not seen any evidence that there are thresholds that we would accept.

I mean there is a debate within the scientific community on this subject, and when any scientist debates over such an important concept as that, we would gravitate to the most prudent cause.

In our experience the prudent thing would be, would be to demonstrate that people with very short term exposures can develop it later on.

MR. KUCHENBECKER: I have some questions for the actual vinyl chloride workers.

Have you, on occasion, used respirators during your employment?

MR. JENSEN: Some of the people in our plant have, but there is a recent development subsequent to the Goodrich situation in vinyl chloride with exposure to vinyl chloride I am speaking of, and other operating situations so yes, they have used them in the past.

MR. KUCHENBECKER: Would you be willing to wear

h.s-17 respirators for a period up to several years in order for the industry to get down to the level OSHA sets?

MR. JENSEN: I think the people would out of necessity, do so, with reluctance, and probably some necessary procedures built in to provide for relief.

Some of these people have breathing difficulties already from the chemical exposure, and other people even a normal healthy person would have difficulty breathing over a long period of time with a respirator, particularly an effective one.

MR. KUCHENBECKER: How about the gentleman on the far left?

MR. BECK: Yes.

MR. KUCHENBECKER: Do you care to respond to these two questions?

MR. BECK: I have never worn a respirator myself. I don't work in the PVC plants. I work in the emulsion plant, but I do work with vinyl chloride, producing vinyl chloride type of emulsion, but we do have the respirators. They have not been issued yet, but we have them.

Every man will have one, and every man tells me he will wear it.

In the PVC plant they are wearing them now. It is not a strict order that they wear them, but they do have them in their possession, and I understand they do wear them at

times when it is most difficult, but they do wear them.

MR. KUCHENBECKER: Thank you.

MR. KLINE: I have just a few questions.

Let us talk about the Goodyear plant for a moment.

In your view, why would the fact that they can reach a level of eight parts per million mean that they can reach a non-detectable level?

MR. MAZZOCCHI: They just started this procedure to arrest the exposure. They haven't reached operating procedure at the present moment.

There is certainly no doubt in our minds that they can reach the non-detectable level with appropriate controls. They are on their way.

The people who work in the facility tell us that they are on their way, and I gather the company has also indicated there are certainly more to be done.

It is only a few months since this whole procedure has been put into effect.

MR. KLINE: Now, are you aware of the length of time it takes to receive equipment that is ordered in order to reduce levels of exposure?

MR. MAZZOCCHI: We are in no position of knowing in every single instance.

I would imagine it is very old, depending upon a whole host of factors that I would be unaware of at the presen

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MR. MAZZOCCHI: I would have to ask.

Are you aware of that based on the monitoring data

MR. WODKA: We can figure that out.

MR. CONNOLLY: Your testimony is based on not knowing that data?

MR. WODKA: I would have to figure out which ones. Do you want a percentage figure? I don't have it right now.

MR. CONNOLLY: What I am trying to understand is the five percent or ten percent of the jobs, or two percent of the jobs, whatever the figure is, that is in excess of ten parts per million that is included in the total picture at least to an average of somewhere around ten.

I am trying to understand from you how you are going to get that ten percent, or five percent, or one percent of the jobs below ten percent by 1974.

MR. WODKA: We indicated in our testimony that the wide and pervasive amount of jobs in that plant are at an average of ten or below except, and we indicated this when I was cross examined by the Solicitor's Department, when it came to reactor cleaning, the evidence in the Goodyear plant shows that the reactor cleaning is above ten and below 50, averages in between there, and it is our position that reactor cleaning will never be a non-detectable exposure level job; that it should be an air supplied space suit kind of job.

MR. CONNOLLY: So that reactor cleaning jobs then,

you would not be asking the Department of Labor to reduce that to the lowest detectable level.

MR. WODKA: I think we were dealing in the realm of reality here, that those operations will never come down to that, and just because they can't come down to a non-detectable level, gives the industry no excuse to excuse the rest of the plant.

MR. CONNOLLY: In the realm of reality are you referring to it as not technological or engineering feasible to get the lowest detectable level in certain jobs, is that what you are saying?

MR. WODKA: I am talking completely within the realm of feasibility on all accounts, economic, technological, engineering.

MR. CONNOLLY: But certain jobs you indicated cannot be gotten down.

MR. MAZZOCCHI: Let me read a letter dated July 2 from one of our representatives:

"With the enclosed readings you will notice that the ppm's are coming down and, in fact, most of them are well below ten ppm.

"I think our problem is going to be reactor cleaning in the bagging stations.

"I also woner what is being discussed concerning the dust in the airborne particles.

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"The company is in the process of trying to bring the dust down with ventilation. A lot can and has to be done. When a man is covered with PVC he stands and blows his clothing off with an air hose releasing a dust cloud in the surrounding area.

"Any (inaudible) lines are blown free in the air which has PISG of 8[illegible] and is breathed into the atmosphere of the working place.

"Steve, don't let the industry try to tell you a bunch of crap, because I worked in a poly plant with those low readings.

"All that is needed is a concerted effort dealing with the engineering technology, and the goal can be reached."

MR. CONNOLLY: Now, I appreciate your reading that self-serving letter into the record.

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MR. MAZZOCCHI: This is a worker in a plant.

JUDGE WYATT: Ask your next question.

MR. CONNOLLY: Relating specifically to the plant, there are engineering controls that are available to get to the lowest detectable limit.

Will you indicate for the record what those engineering controls are?

MR. MAZZOCCHI: I can't do this at the present moment.

Mr. Bommarito's statement in response to Mr. Kline's question.

MR. WODKA: Again, I go back to my own statement saying where the burden ofproof should be on the industry ther should be a deadline.

If there is a legitimate reason why you can't meet that deadline, then you ought to come forward.

We can't conceive of every-particular set of circu stances in every particular plant in the United States.

There may be a situation, and it may be in a plant that you are at, or you are speaking for. It may be. We do not know.

Our experience demonstrates that we think, and bas on what we have said, they can meet it.

The exceptions, there are remedies. It is another part of the Act.

MR. CONNOLLY: Are you saying then, that I presume you are saying, that there are some jobs that cannot be reduce to the lowest detectable level, and in these jobs every compan in the country that is in this industry will have to come in and request a variance.

MR. WODKA: We think certain jobs you will never reduce it, reactor cleaning.

MR. CONNOLLY: So that every company in October would have to come in and ask for a variance.

MR. WODKA: The way we conceive of it, and I have

to check the standard, the proposed standard again, but the standard would be written in such a way that where it is technologically not feasible, for example, reactor cleaning, to bring it down to a non-detectable level, then that environment becomes a space suit air-supplied respirator kind of job, and there would be no need for the companies to come in for a variance, because that would be indicated in the standard.

MR. CONNOLLY: Now, as Mr. Kline, I believe it was asked you, is it your feeling that if equipment is not available to reduce the level for the companies in other areas, other reactor cleaning between now and October of 1974, and that equipment was one or two years away, that every company would be coming in in [illegible] variance, and abatement periods would be set up?

MR. [illegible]: We hope the companies approach the problem with candor, and based on the problems of the feasibility of the situation.

If they have a problem, they use that part of the Act that allows them to use the variance procedure.

At that time, the onus would be on them to demonstrate they can't do certain things at a certain time.

We taken them up point by point. These would not be blanket exceptions.

MR. CONNOLLY: When you suggest that different companies might be in obviously different situations, are you

suggesting that a different standard might be appropriate for different types of companies?

MR. MAZZOCCHI: No, we are not. We are saying that the Act addresses itself to that point, allowed a variance.

It gives them a period of time to come into compliance.

It allows [illegible], and we say where a company can legitimately demonstrate that it needs the variance and can provide equal protection as called for under the Act, then we would take that up on an individual basis.

MR. WODKA: In other words, we propose that all of our members throughout the three parts of the vinyl chloride industry be covered by a non-detectable exposure limit.

MR. CORCORAN: [illegible], Mr. Mazzocchi, that industry in the asbestos case came in and indicated that it was not economically and technologically and engineering feasible to get down to low levels, and this has not proven to be the case.

Is it not a fact that the number of companies have been unable to reduce the asbestos exposure to the acceptable limits at this juncture?

MR. MAZZOCCHI: We have an experience in doing a poll showing that companies that [illegible] to attempt to meet the standard, yes, less than one percent in our industry, less than three percent in our industry, less

than one percent in the asbestos installation industry have even made preliminary steps to meet the standard.

We know of no company who has tried and failed to meet it.

MR. CONNOLLY: Do you know of companies that have tried and have met it?

MR. MAZZOCCHI: Oh, yes, sure.

MR. CONNOLLY: The five level?

MR. WODKA: One of the most telling things is that the company that cried the most at the hearings in 1971, Johns Manville, is now the company that it is our understanding meets the two fiber limit.

MR. CONNOLLY: You know of any companies that are going to have problems meeting the two fiber limit in 1976?

MR. WODKA: No, we know of none, and I think it is just telling again that when industry tries to set up a false front, that they cannot meet the standard, while in reality, after the standard comes out, it turns out that it was much easier than everybody thought.

MR. MAZZOCCHI: And secondly, the company that can't meet it, have a remedy under the act, that is the variance procedure.

If we see any variance that comes in, we will look at them.

MR. JENSEN: Johns-Manville is now down to .6, and

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PLANT.

MR. BARR: You ever see me around the plant?

MR. BECK: Yes, sir, you started with me.

MR. BARR: And do you still now see other foremen and supervisors, engineers and plant managers in the plant?

MR. BECK: Yes.

MR. BARR: Then it is not entirely just union workers who are exposed to vinyl chloride, but actually it is the men who are making the effort to reduce the levels are also exposed, is that correct?

MR. BECK: They are exposed, but not to the extent that the workers are.

For instance, in the emulsion plant it is very seldom that a supervisor will go into the area where vinyl chloride would be.

There is not too much in the control room. Most is out by the reactors and the premix tanks and blenders.

MR. BARR: Yes, sir, I know that particular plant, but in the other plants, and particularly in the PVC plants there are other people than union people in the area.

MR. BECK: There certainly is at times, but as I said, not to the extent that the others are.

MR. BARR: I understand. I understood the thrust of your testimony as regards Air Products and Chemicals, Inc. It was that you had not received the results of your physical

examination, is that right?

MR. BECK: I have not.

MR. BARR: Didn't you get a letter dated April 17 signed by Mr. Jack Kramer, the Works Manager, stating the results had bee obtained by the doctor, and without going into personal medical details, giving you the gist of your results, and telling you the results would be available to you through your personal physician if you so requested?

MR. BECK: I was told if anything, for instance, like angiosarcoma was found, of course, we would be notified, and if anything to any extent was found wrong our personal doctors would know about it upon request.

MR. BARR: But you did get this letter that I am speaking of?

MR. BECK: I got it. I got one stating that all of my tests were okay except one, and that it should be repeated.

MR. BARR: And that test has been repeated very recently?

MR. BECK: Yes, it has.

MR. BARR: And you had a conversation with Mr. McMillan, and last week, in which he told you the results had just been obtained, and letters were in preparation giving you and the other people who went through that three month repeat, that these letters were in preparation to be sent out, is that correct?

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MR. BECK: He said that you would give me a copy o this when I got to Washington before I testified.

MR. BARP: I think, sir, you are referring to another letter. I don't have a copy of your medical records.

I think he was referring to the letter of transmittal of the testimony which was given here, which is also in the process of being sent to all employees.

Is that not the letter he was referring to?

MR. BECK: Well, I understood he, or contain the results of people that said something was wrong, that was my understanding at that time.

MR. MAZZOCCHI: That is the point we are making, this cavalier attitude that the plants work managers, the medical departments transfers through, that you come here with his medical records, or that the letter states there is nothin basically wrong with you.

We are tired of being treated that way. We want to know precisely.

We want the ability to go to our own consultants

I suggest you look at the record of Tyler, Texas, where we are going to have four to 800 people die of angiocarcinoma, and OSHA knew precisely what was going on.

We don't attempt to have everybody's grandmother read the medical records of these individuals.

JUDGE MYATT: All right, gentlemen, this is servin

In one of our active plants we use 3,600 pounds of resin per day -- per 8-hour day and the supplier states that the free VC in the polymer we use is less than 50 parts per million. If there were no leaks in the building and all the released VC stayed on one floor, at the end of the day's work we'd have a concentration of .016 parts per million in the room, a quantity which is not detectable by the method specified.

Consequently, when concentrations in local work areas exceed the detectable limit, they can easily be reduced to non-detectable levels by a fan which quickly mixes the VC with the air in the room. Better, would be a hood over the specific workplace exhausting to the outside air. This would easily keep the concentration at the workplace below the detectable limit.

And I'm injecting here what I think you see, is that we feel that engineering -- the engineering part of the requirement of the law is something that could be exercised. It is the concurrency that we object to, that at the same time we must go to the costly control methods.

Back to the paper: therefore, there is no need for such a plant to use respirators, protective clothing, and medical surveillance. Consequently, we recommend that those requirements be removed from applicability to PVC fabricators.

Our fourth contention is that the cost of providing

Division. Perhaps more pertinent, the qualifications. I'm a chemist by training and for nine years, from 1948 through 1956 I was involved in research and development in the manufacture of vinyl chloride and polyvinyl chloride.

In the subsequent years I've been successively Marketing Director and Research and Development Manager for Uniroyal's PVC operations.

And my associates, on my immediate left is Dr. [illegible] Harris, our Corporate Toxicologist and Mr. [illegible] Heath, Factory Manager of our Painesville, Ohio, PVC manufacturing facility.

Mr. Wahler is not here.

Uniroyal has been in the business of manufacturing vinyl chloride monomer and polyvinyl chloride resins for over 27 years. We're one of the world's largest manufacturers of vinyl products, such as, for example, coated fabrics under the better known name of Naugahyde. We've been in that business for over 33 years.

We were the third producer of PVC in the U. S. and we haven't expanded very much, so we've become a relatively small factor in the business. We represent about 3 percent of the total U. S. production. It is noteworthy, however, that with only 3 percent of the total production of these resins, we affect about 25,000 employees in the customers' fabricating operations who are dependent at least in part upon our resins.

A simplified extrapolation of this ratio for the

without such exclusions or exemptions the standards, "...would -- and I quote in part again -- "...would have the effect of closing down large segments of industry, such as steelmaking, wood preserving, smelting, aluminum reduction, and possibly even power plants."

The polyvinyl chloride industry is the single most important segment of the entire U. S. plastics industry. The annual output of base resin is close to five billion pounds per year. A recent survey projects growth to [illegible] billion pounds in 1980.

I think it's very important and it should be recognized that the growth of PVC to this tremendous usage stemmed from the unique properties of this resin. Uses and fabricating techniques have for the most part been developed to handle PVC and are not easily adapted, or adapted at all, to other materials. One does not simply substitute rubber or some other plastic material without substantial changes in skills, equipment, and capital costs.

Many small users who have put their total savings into fabricating equipment for PVC would have to just go out of business because it would take a like amount of money to go into a substitute material.

And the total worth of the PVC industry in terms of jobs and dollars is difficult to measure exactly, but it is known to be responsible for hundreds of thousands of jobs and

MR. LEACH: Well, I don't really know what you mean by "engineering controls;" we changed our method of operation. We have planned for equipment changes which, hopefully, if we have a permitted level to operate at, we will purchase different equipment and install it.

Is that the answer to your question? Perhaps I don't understand.

MR. KLEIN: Well, you have answered my next question.

Have you put in new equipment with the aim of having the level of exposure reduced?

MR. LEACH: Yes. Primarily this has been, so far, respiratory equipment.

MR. KLEIN: Other than respiratory equipment, have you put any equipment in with the aim of reducing the level of exposure?

MR. LEACH: No.

MR. KLEIN: Now, you talked about work practices which you instituted that had the effect of reducing the level of exposure. Would you describe them to us, please, briefly?

MR. LEACH: Yes. We have had a certain level of reactor venting prior to personnel entering the reactor for cleaning, and --

MR. KLEIN: Excuse me; is that a change in policy?

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MR. LEACH: Well, just a minute; let me finish.

We have had a certain level of ventilation, which was our standard; based on the obvious need to reduce personnel exposure, we have greatly increased the air-flow rate through reactors whenever people are in there.

Also we have increased, or lengthened, the time of sweeping before anybody goes in there. Also, we now require that all those entering the reactor vessels for cleaning wear respiratory protection.

MR. KLEIN: Are there any other major work practice that you instituted which have had the effect of reducing overall exposure?

MR. LEACH: We have tried certain things, but I have -- customers have reported to us that certain things we have tried have had an adverse effect on quality.

MR. KLEIN: Does that have to do with the recovery of unreactive monomer?

MR. LEACH: No, it does not.

MR. KLEIN: Would you tell us some of the things you have tried that have had an effect on the quality of the product?

MR. LEACH: Yes. Increasing the number of batches between vessel cleaning obviously reduces the individual -- the number of times that people must go into the reactors, but as we try this we begin to get quality effects that are

untenable.

MR. KLINE: Is that --

MR. LEACH: That is the major thing that I am thinking of.

The business of removing more monomer from the polymer during manufacture is one where we must install the equipment to do it. This gets into what we are now planning, but we are waiting to see which way the cat is going to jump before we commit the money to it.

MR. KLINE: I am not sure I understand what you mean. Would you explain what you mean, please?

MR. LEACH: Well, equipment installation will be required in order to achieve lower levels of vinyl chloride in the PVC -- stripping or whatever procedure we use to reduce the VC content of our PVC plants, and we have not yet committed ourselves to installation of that equipment until we know what it is that we are going to have to do.

MR. KLINE: I am not sure I understood that, either.

MR. KLEINFIELD: Frankly, I can answer that a little more bluntly.

If the standard comes out that says no detectable level, we will not commit any money to equipment, because we feel it is unfeasible. If we're not going to make it, why spend the money? We will never accomplish it. So we will

MD-10 chloride subsequently in liquid form, increased ventilation on and on and on.

We have over the last three months had practically all of our engineering people directed toward finding what the things are that we can do to come up with a program so we have something to talk about each day, and there aren't very many.

MR. KLINE: Are there any other engineering control that you contemplate instituting which will -- you feel will get you down to the 10 time-weighted average?

MR. LEACH: We don't have the people associated with PVC that Mr. Batone mentioned, but such people as we have assigned to research and development for PVC are all working on this problem, looking for techniques such as either a higher conversion of the polymerization operation or the removal of the unreactive monomer someplace in the process steps.

We are contemplating a lot of things; only when we have done sufficient work will we know which of these has any practical application.

MR. KLINE: Incidentally, I am curious as to why you are trying to get down to ten parts per million time-weighted average if you feel 50 is safe.

MR. LEACH: I didn't say 50 was safe. I am saying 10 is something I think I can reasonably get to with my

manufacturing operation.

MR. KLEINFELD. I think we have to differentiate. We are being told we are going to be required to get down to no-detectable level. Now, we have to make preparations for that.

We are saying we can approach it but we can't quite make it. That has little to do with what we think is safe.

DOCTOR HARRIS: I think I may add that it is just the basic philosophy of Uniroyal, and I think of most responsible companies, that certainly when we recognize that there is a potential hazard, we go as far as we know how -- even beyond what we think we have to, if we see a way to do it. We try to get as low as we can.

PVC dust is still considered a nuisance dust, but we don't believe that people should be exposed heavily to any dust, so we try to keep it as low as we reasonably can. And as Mr. Leach has indicated, one should -- once you really start studying it, it is surprising what you can do, but it does take time. And what we have been objecting to is the hurry-up pressure approach, which requires you to get to zero median level, and we just don't know how to.

We are saying that we don't know how to get there at all, to zero.

MR. LEACH: May I respond again?

I am not attempting to be flip when I say 10. We

ng 10

It is a series of short messages.

MR. KUTHENBECKER: We would appreciate that being part of the record.

Secondly, I assume that you are going to reach a final conclusion of the survey.

If that is going to be reached before the record closes, I would appreciate that also to be submitted.

MR. [illegible]: Yes, sir, we will comply.

MR. KUTHENBECKER: Thank you.

Let us discuss monitoring for a moment.

Have you conducted any monitoring programs at all in your various plan operations?

MR. LAVALETTE: Yes, sir.

We have monitored all operations within Stromberg-Carlson using the PVC wires, using the extrusion process.

MR. KUTHENBECKER: What were your results; did you find out anything?

MR. LAVALETTE: I am not prepared to discuss the results in detail but I am more than happy to tell you in general what they were.

MR. KUTHENBECKER: If you could do so briefly, I would appreciate it.

MR. LAVALETTE: At the work stations, the results were two to five parts per million in the breathing zone.

These were representative readings that were not

[illegible] 11 higher.

The only thing we found higher than that was [illegible] sample and sniff the inside of the shipping cart, of which we received pellets, someone to stick his nose in the box and that was, to my recollection, forty parts per million PVC.

MR. KUCHENBECKER: Since the vinyl chloride problem has come to light in 1974 have you instituted any work practices, any new engineering methods to reduce the exposure of vinyl chloride to your workers?

MR. [illegible]: No. We are well aware there certainly is enough question in our mind that we need to do something.

We made those measurements and we are continuing to make measurements.

We are also doing some engineering work to see the feasibility of reducing the load levels that we have even now in Rochester, New York.

We feel that we can reduce them.

How close to zero we can come, we don't know, and that will have to be prepared and shown, I am sure.

That is the extent of what we have done.

MR. KUCHENBECKER: As far as medical surveillance to your employees, do you have a plant physician in your location site?

MR. [illegible]: Yes.

We do. We do have a plant physician in Rochester.

JUDGE MYATT: All right, sir, proceed.

STATEMENT OF DAVID A. DE CHITTO, MANAGER,

ENVIRONMENTAL CONTROL FOR CARLON, AN

INDIAN HEAD COMPANY

MR. DE CHITTO: Judge Myatt, my name is David De Chitto. I am the manager of Environmental Control for Carlon.

This is a recently created position; my previous experience includes seven and a half years of plant management for my company.

Carlon is the largest manufacturer of PVC pipe and fittings in the U. S. In 1973 we produced 200 million pounds of product in six plants located throughout the country. Two additional plants have been added in 1974.

We employ approximately 1,000 hourly workers and operate the plants seven days a week, 24 hours per day, year-round, except for brief shutdowns at year-end holiday time.

Our manufacturing operations include compounding, extrusion, and molding. The PVC resin and additives are purchased from outside sources. The compounds are used only internally and are made at four plant locations for use therein, or shipped to other Carlon locations.

PVC resin is received in bulk rail cars and trucks. A typical Carlon blend facility will handle in excess of 50 million pounds of resin per year. Since resin is the major

component of all compounds, there is a direct connection between the resin producer and we as a resin consumer. With proper safety and ventilation procedures, our plants would have no problem in making sure that workers are protected from levels of VCM at or below any recommendations made at this hearing for plastics manufacturers or fabricators.

If a non-detectable level were promulgated, it would be impossible for operate any of our facilities, even using any of the recommended breathing apparatuses. Our work force is highly mobile, moving throughout large areas of the plant as part of normal activity. Any restriction on sight, hearing, or smell would eliminate sensory mechanisms vital to personal safety and equipment operation.

Of utmost concern to us is the general scope of the proposed standard. It is incorrect to lump together all industry groups -- monomer, polymer, fabrication/processing -- in a common standard.

By all evidence presented, our manufacturing operations result in minimal worker exposure. Even in areas where exposures are relatively higher, this exposure is brief.

We recommend that appropriate study be made regarding the three-part manufacturing nature of the vinyl chloride industry and that a reasonable and correct standard be established for each.

JUDGE HYATT: Thank you, sir.

Gentlemen, questions?

MR. [illegible]: I have a few general questions I would like to ask.

[illegible] state that two additional plants have been added in 1974. Have you been able to equip these plants with any [illegible] control devices, to limit the exposure to vinyl chloride?

MR. DE GUNTO: The plants that were added in 19[illegible] include one that was designed back in 1973 and would be the up-to-date technology that we understand to be necessary to operate a plant. The other is a recent acquisition.

MR. [illegible]: So I take it you have done [illegible]

[illegible]

MR. DE GUNTO: That is correct, in the sense that we have not really addressed ourselves to either the proposed standard, and have only recently begun to do the monitoring work required as part of the temporary standard.

MR. [illegible]: Did you do this monitoring yourself?

MR. DE GUNTO: I was personally involved in setting up the monitoring program, and have now passed it on to people in each of the plants.

MR. [illegible]: Do you have any preliminary data available on this?

MR. DE GUNTO: The data has not been accumulated

the record?

MR. DE GHETTO: Yes, I can.

MR. KUCHENBECKER: Thank you.

On page 2, the second paragraph, you begin with the statement, "If a non-detectable level were promulgated, it would be impossible to operate any of our facilities even using any of the recommended breathing apparatuses."

What basis did you have for this statement?

MR. DE GHETTO: What would happen at a compounding facility is that at certain points in the operation, due to the heating of the material, there would be a tendency to liberate some of the monomer that might not be present, or at least detectable under the circumstances, and with the operating crews having cased to work in a three-story building, and then the introduction of maintenance people on an "as needed" basis, I think very soon the operation would become totally bogged down, and logistics problems you could not cope with.

MR. KUCHENBECKER: This conclusion is your own judgment, based on your own experiences?

MR. DE GHETTO: That is correct.

MR. KUCHENBECKER: Third paragraph on page 2 states, "It is incorrect to lump together all industry groups", and I take it, then, you prefer a standard to cover just fabricators. Do you have any specific recommendations to cover

yourself?

MR. DE GHETTO: We have no specific recommendation. We are a company that is a fabricator by your definition, and we do go along with the SPI recommendations, and from our point of view, being an operational type company, without a chemical staff or analytical staff, we find that those groups that are expert in these areas should be looked to by people such as us to indicate where we belong.

MR. KUCHENBECKER: Getting back to the initial findings you mentioned, as a result of your early monitoring do you foresee any problem of getting down to approximately one part per billion by October 5, 1974?

MR. DE GHETTO: I would think -- and we do not have any data on residual monomer from our supplier -- I would think if the production were improved between now and October, the one part per million would be a possibility, yes, sir.

MR. KUCHENBECKER: All right. Thank you.

MR. LASSITER: I had one question.

Did you say that the resin were blown to your facility from the producer?

MR. DE GHETTO: That is correct.

MR. LASSITER: In other words, how far away is the producer located from your facility?

MR. DE GHETTO: Approximately 500 feet.

at concentrations of 1 part per million with an accuracy of plus or minus 50 percent. It would be helpful to know that OSHA will accept results based on an identical method of sampling and analysis.

I would like to add some final comments which are not included in my prepared statement.

Thus far we have conducted 48 tests for vinyl chloride in four plants in both general and personal breathing zones. These measurements have been taken in storage, mixing, and extrusion areas of the plants. Of the 48 samples, 46 appear to pass the proposed standard. Two measurements taken over a freshly opened box of compound indicated a VCM presence of two to three parts per million.

Although our monitoring program is thus far not complete, the evidence suggests that residual VCM encountered in the plants of PVC resin users is not a serious problem. Deviations above the proposed "no detectable level" as defined can probably be handled with improved ventilation.

We believe consideration should be given to adoption of separate standards of monitoring for vinyl chloride processors and PVC resin users. If the OSHA standard adopted contained a requirement that residual vinyl chloride monomer in PVC resins be below certain specified levels, as suggested by some witnesses, there might be no need for monitoring at all in the plants of PVC resin users as the amount of residual vinyl

chloride monomer entering those plants would be minimal.

Thank you for giving me the opportunity to testify.

JUDGE [illegible]: All right.

MR. KNICKERBOCKER: Your last statements regarding the monitoring were very interesting.

Could you possibly supply us with the monitoring data that you have so far?

MR. NICHOLS: Yes, we could submit that to the record at a later point in time. I don't have the test results with me, but we would be happy to supply you the information as it develops.

MR. KNICKERBOCKER: Right.

Proceeding a little bit further, you mentioned the low levels that you had found in your initial tests. Do you foresee any problem at all as far as getting down to the 1 ppm level by October 5th, 1974?

MR. NICHOLS: Our sampling is not complete. We haven't tested all our plants yet. But based on what we've determined thus far, it doesn't appear that we have a serious problem. The only areas where concentration appears to exceed the proposed standard in our plants is where there is stored material, and those are usually not personal breathing zones, so it suggests to us that just possibly improved ventilation is all that we would have to do, but we can't be certain until we've completed all our tests.

MR. KUCKENBECKER: I take it that your plants are all concerned with the extrusion process, the fabrication; is that correct?

MR. NUCKOLS: That's correct, and some with compounding.

MR. KUCKENBECKER: Have you monitored in these particular areas where the compound is extruded?

MR. NUCKOLS: Yes, we have.

MR. KUCKENBECKER: What were the findings there?

MR. NUCKOLS: The levels were generally the "no detectable level" as defined; some were less than .05 parts per million, some approximately 1 part per million.

MR. KUCKENBECKER: I don't believe I caught it, if you did say it. Do you know the levels of vinyl chloride monomer residue that were found in the PVC that you received?

MR. NUCKOLS: I beg your pardon?

MR. KUCKENBECKER: Are you aware of the vinyl chloride monomer residue level in the polyvinyl chloride that you receive from your suppliers?

MR. NUCKOLS: Some tests have been conducted. They haven't been extensive yet. But the highest reading recorded was 28 parts per million in the supply of resin from one supplier.

MR. KUCKENBECKER: You mentioned both pellets and resins. Is this the pellets?

MR. NUCKOLS: Resin is mixed with plasticizer and

MR. KUCKENBECKER: Let me direct your attention to page 2 of your testimony. In the top paragraph you state that the vinyl processing portion of your operation is the biggest part of your business. What percentage is that?

MR. STEERE: About 67 percent of our business.

MR. KUCKENBECKER: All right. As far as the monitoring that you have conducted, you mentioned that in your resin storage area you find 2 to 14 parts per million. Is this the -- I haven't had a chance to look at the data. Is this the highest level of exposure?

MR. STEERE: Yes.

MR. KUCKENBECKER: Generally, what are the levels of the other points and what are they that you mentioned?

MR. STEERE: Well, the other areas are various parts in our processing plant where the people are working, in the stack gases, in the mixing area, and so forth. In all cases we were unable to detect any vinyl chloride monomer gas.

MR. KUCKENBECKER: This was conducted before any engineering controls had been instituted in your plant?

MR. STEERE: That's correct.

MR. KUCKENBECKER: Now, I assume that none have been instituted since then; is that correct?

MR. STEERE: That's correct, yes.

We have substantial ventilation throughout our processing area, and I presume that that's the reason we're picking

nothing up.

MR. KUCKENBECKER: The ventilation, of course, was ongoing at the time of the monitoring?

MR. STEERE: That's correct.

MR. KUCKENBECKER: The resin storage areas you mentioned, could you tell me whether employees frequently go into this part of your plant?

MR. STEERE: No; that is in a separate plant away from our processing plant, about -- a couple of miles removed, actually, and very few employees ever are in that area.

I think ventilation there probably would eliminate the buildup that we noted.

MR. KUCKENBECKER: Could you give me an idea of how many employees in a typical day go in there, how many times?

MR. STEERE: Well, I'll have to just make a very general sort of guess, but two or three at the most, and they might be in there once or twice a day. It's strictly a warehouse area and we only go in there to get the raw material out.

MR. KUCKENBECKER: How much time do they spend in there during these two or three times?

MR. STEERE: Well, I can't answer too accurately -- I hope not too much -- just to go in to get the skids of material and put it on the truck.

MR. KUCKENBECKER: These are pallets, for example --

MR. STEERE: Yes.

MR. KUCKENBECKER: -- of bagged PVC resin?

MR. STEERE: That's correct.

MR. KUCKENBECKER: You've mentioned the medical information supplied by Dr. Butler (sic). Have you submitted his entire report dealing with the examinations of your employees?

MR. STEERE: Yes. You will see attached photocopies of the lab reports from Akron General Medical Center on Mr. Butler. This was done at the direction of Dr. Braun, who is his doctor, and I asked him to send me a covering letter similar to the one that Dr. Bartholome had sent from the Akron Clinic and he said he didn't have time, but that the lab tests, where those that were knowledgeable about this, would be far more informative.

MR. KUCKENBECKER: Do you foresee any difficulties in getting down to approximately 1 part per million by October 5th?

MR. STEERE: I didn't understand the question.

MR. KUCKENBECKER: Do you foresee any difficulties of lowering the vinyl chloride exposure to your workers down to approximately 1 part per million by October 5th?

MR. STEERE: I would say that now that we have achieved that in all areas except the warehouse -- and I think ventilation in the warehouse will handle that.

MR. KUCKENBECKER: Are you planning any efforts to ventilate?

(No response.)

JUDGE [illegible]: All right, sir, thank you.

Statement of [illegible] will be designated Exhibit 46.

(Document referred to was marked as exhibit 46)

JUDGE [illegible]: Is there someone here from Kessler Products?

All right, sir, proceed.

STATEMENT OF GERALD KESSLER, CORPORATE OFFICER OF KESSLER PRODUCTS COMPANY, INC.

MR. KESSLER: My name is Gerald Kessler. I am a corporate officer of Kessler Products Co., Inc. Kessler operates a vinyl extrusion plant in Youngstown, Ohio, and a molding plant in Dover, Ohio.

We have been in the vinyl extrusion business for about 25 years, and to the best of my knowledge, have had no cases of angiosarcoma. Being a small business, all of the officers and supervisors have had extensive personal exposure.

Our plant is well ventilated with roof exhaust fans, wall exhaust fans and a professionally designed and installed hood and duct system for each extruder. The results of the presently required monitoring, (performed by environmental labs), show less than .5 ppm in almost all areas, with a maximum of 3 ppm at the ribbon blender.

mk3 However, I do not think that we could reduce the levels to less than [illegible] ppm 100 per cent of the time.

[illegible] that the "no detectable level" requirement would shut them down, and this in turn would shut down our extrusion plant causing the loss of about [illegible] jobs directly.

Our customers would have great difficulty in finding substitutes for our product and would be likely to be shut down, causing further losses in jobs.

I feel that even if the resin producers could completely [illegible] and eliminate all [illegible], the small independent processor would always have some very low level of [illegible] in all processing plants whether they are plants like our [illegible] plant, which is almost 100 per cent vinyl ex- [illegible] or other plants [illegible] about five per cent vinyl or plants containing one vinyl extruder with several hundred employees in other work.

I feel that the complete plant should be monitored, not just the immediate extruder area. It should be mandatory that the results of the monitoring should be routinely furnished to a central OSHA data bank along with such medical records of all employees of the plant that are deemed necessary and practical by qualified medical and statistical experts.

I cannot get my mind to work in terms of approximately one, you know? I need to know one part or three customers.

[illegible]

I am not attempting to be facetious.

However, we do get quality control specs like that sometimes.

Just so make sure you understand, I do not believe that a processing plant in present-day technology, plant like ours, can get down to one per 100 per cent of the time by October 1.

Now if you take an eight hour time weighted situation, then we would certainly be under one-half part right now.

[illegible] actually is only exposed to that position approximately a maximum of five minutes, at a time, approximately 12 times a day as he does his work.

So if you time weighted that on an eight hour basis yes.

[illegible]: Would it be fair to infer from your testimony that you have no objections to monitoring requirements that are present in the proposed standard right now?

MR. KESSLER: I am not sure whether they are the proper types of monitoring, that is why I say this should be discussed by qualified statistical people which I am not.

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2. There was no significant increase in deaths from any specific malignancy, comparing the employees who worked in Firestone's PVC facilities and were exposed to VCM with those who worked in the tire facilities and were not exposed to VCM.

3. There is no difference in all causes of death among the [illegible] deceased employees who were exposed to VCM for more than ten years as compared with the fifty-three deceased employees who had shorter exposures. Among the twenty-two malignancies in the group of employees exposed to VCM, there is no difference in type of cancer in those exposed more or less than ten years -- except, again, for the one angiosarcoma previously identified in the longer exposed group. This finding, we believe, is of extreme significance.

4. Based on a review of the Tabershaw-Cooper study in addition to other scientific studies, particularly those of Viola and Maltoni and on the review of Firestone's death certificate materials, Dr. Baden concluded: "The issue of threshold still remains to be resolved but there may be a level beneath which exposure to vinyl chloride is not harmful."

Physical examinations and an exhaustive set of liver function tests are also being performed on Firestone's current Pottstown and Perryville PVC employees. Although superhuman efforts have been expended by Firestone's medical department and the Department of Pathology, Northwestern University

diminish their alertness and concentration resulting in poor work and frequent mistakes.

In the course of performing the requirements of various jobs in the plant, employees must move rather extensively around the equipment, between floors, up and down stairs and distances of 50 to [illegible] feet and more from a fixed station. Such requirements [illegible] stations and hoses notably impractical [illegible] the alternative is a portable [illegible]

The mask weighs approximately [illegible] pounds and provides an air supply of about 30 minutes [illegible] safety factor of 10 minutes. [illegible] supplies weighing up to 50 or 60 pounds.

Moreover, changing of tanks would also inhibit mobility because in changing tanks the employee would have to be in an area containing undetectable levels of VCM. This would require an employee to leave his work area unattended, a safety hazard in itself, in order to effectuate tank change.

Tank change areas would have to be specially built and be securely isolated from the work area in order to guarantee noncontamination. Due to these various factors and inconveniences, Firestone's operating personnel have estimated that probably 25 percent of the present employees would either terminate employment or [illegible]

MR. KUHLMEIER: I haven't been able to find it [illegible] before.

[illegible] move on.

[illegible]

MR. [illegible]: [illegible] direct your attention to page [illegible]

MR. [illegible]: [illegible]

MR. [illegible]: [illegible] paragraph, you [illegible] -- you believe the rest of the industry [illegible] been able to reduce vinyl [illegible] the concentration ceiling levels in many areas of the operation to less than 50 parts per million.

MR. [illegible]: Yes.

MR. [illegible]: How long did that take?

MR. WALKER: How long did it take?

MR. [illegible]: Yes.

MR. WALKER: I would say we did [illegible] companies. We've [illegible] operating at a 200 ceiling.

I don't think we were anywhere near [illegible] for the last year [illegible] when the temporary emergency standard came out we did have to take some very quick engineering changes.

Now, I heard it said before here, when you have a problem you start looking, you do notice a lot of things.

[illegible], we [illegible] and

a number of changes.

We have put all of our reactors had drop line ventilation as we call it, so we pull it out through a compressor, not blow it out into the reactor room.

Any emission that was inside the plant, we immediately piped to the outside, outside the plant. We instituted [illegible] practice procedures in unloading how you purge or blow out the [illegible].

We raised exhaust stacks on every roof to get them higher and higher so we're not blowing it out the roof and bringing it in the window.

Now, this collection is what I say is the reasonable type of controls, things that were done in 90 to 120 days and enabled us to get our Pottstown plant, for example, down to 50 ceiling with the exception of eight places which are clearly posted demanding for respirators. Those aren't going to be short-term solutions. Those are going to be long-term.

MR. [illegible]: As far as your other plant, how were you able to get down on that location?

MR. WALKER: We have in Perryville two or three spots that are posted which are commonly over 50 versus eight places in the Pottstown plant.

Perryville is six years old, much more modern, much more spacious.

Pottstown is 27 years old but in both plants we have

furnish your most recent data on exposure of job classifications?

MR. WALKER: [illegible] it will, we would be happy to.

MR. KLEIN: And if you can approximate the length of exposure as well. Would that be too much of a burden?

MR. WALKER: I am not quite sure what you mean. Each employee very clearly says whether it is a ten minute sample, [illegible] whether it's a [illegible], whether its in 8 hours. Is that what you are reading?

MR. KLEIN: You have TWA's available, is that what you are suggesting?

MR. WALKER: No. Most of the samples we are using, we are trying to spot the trouble areas, so we are using ten minute samples [illegible]. A spot check occasionally would be eight hour air bag, but it is broken up mostly by area.

MR. KLEIN: Now, I get the impression from your testimony that you are reluctant to expend large sums of money unless you are sure you can reach a particular level. Is that an unfair inference?

MR. WALKER: No. I think what we are saying is that it is almost impossible accurately to forecast sums of money which will be increasingly required to decrease the exposure level.

For example, incineration, decontamination, carbon absorption, whatever you want to call it, of those exhaust

[illegible] when you are trying to get to a very low

[illegible] incineration. You can't blow it

[illegible].

[illegible] you say how much does it cost, you will

[illegible] $5 million, the

[illegible]

KLEIN: [illegible] in terms of reaching

[illegible]

MR. [illegible]: Well, you are [illegible]

We say up to $10 million to get everything below

[illegible], it depends on whether we have to go

[illegible] incineration.

[illegible], and

[illegible], we are not going to spend $10 million

KLEIN: Your reluctance to [illegible] recommend-

[illegible] to be based upon a feeling that it is speculative

[illegible] whether those levels can actually be reached?

MR. [illegible]: That is right.

MR. KLEIN: Or those levels.

MR. [illegible]: That is right.

MR. KLEIN: The impression that I had from your testi-

[illegible] like to clear up, is that you were reluctant to

[illegible] sums of money if you weren't sure that you could

attain a particular [illegible] level.

MR. [illegible]: We are going to spend the money

regardless of whether OSHA sets a standard of 50 or [illegible], and [illegible] don't mean that facetiously.

What we don't know is when we are all done spending it whether we have a 25 ceiling and a ten TWA, or a 15 ceiling and an eight TWA, or it really is a 40 ceiling any way.

We don't know. But we are already committed. We already have half a million dollars worth of monitoring equipment on order. That is a 90 point system for the [illegible] plant, it is a 72 point system for the Perryville plant, readings every four to nine minutes on each spot. That money is being spent.

The medical surveillance, we are through. We have millions of dollars right now, approved by our corporate people, to again reduce the -- the only thing that is different in our presentation is we are going to tell you after we put it [illegible] what we have done. But [illegible] by saying [illegible] you [illegible] to hear [illegible], we will say [illegible].

MR. [illegible]: I [illegible] try to rephrase it one more time.

Are you suggesting that OSHA set only a standard which you are sure you can attain?

MR. [illegible]: I think that we are telling, or suggesting to OSHA that it set a standard that is based on fact; that at 25 and 40 it is considered medically proven with the kind of data that has been presented here, why set it for [illegible]

DR. LASSITER: Excuse me. Let me finish and I'll give you the whole question. Do you feel that positive findings of carcinogenicity in rodents must be backed up by such findings in higher animal species prior to control of carcinogen that man might be exposed to?

MR. BADEN: I wouldn't put a tremendous weight on dogs or monkeys as opposed to humans. I think what we really are concerned about is the incidence of carcinoma to humans.

One can extrapolate only with great care and difficulty from any animal species to human animal species. I think there is some evidence that there are tumors that are produced in animals, in say, rodents, that might not be produced in the monkeys, for example.

I wouldn't stress the point of the dogs and minkeys.

What I would say is that one can't, in general, extrapolate automatically from animals to humans without a lot more further information. I think that the human material is available, and that is what is significant, and that is what should be looked into and evaluated in setting standards.

DR. LASSITER: In view of the finding of the same tumor in both mice, rats and humans, do you feel that this chemical offers one of the best instances of extrapolation of animal data to man that we know of?

MR. BADEN: My personal opinion would be yes, there is cardinal effect between vinyl chloride and angiosarcoma.

I think that incidences and the risk is what is at issue, and that there may be levels of vinyl chloride exposure in humans that are not harmful and not carcinogenic.

But I do think that there is a cordial relationship in cases presented in humans and animals, yes.

DR. LASSITER: Okay. I will talk about the epidemiology later.

The case that we are talking about here is the use of higher animal species to back up what is already found and what I'm asking here is this sufficient or necessary in your opinion in the view that the same type of tumor has been found in rats mice and hamsters that has been found in man? Do you feel this would be ancillary type data if we use higher animal species?

MR. BADEN: I think it would be another piece of information to be considered.

The most critical data, data relied on ultimately is the experience in humans. Not that vinyl chloride doesn't cause angiosarcoma, but in humans can -- are there levels of exposure, that does not cause any pathological harmful effect.

And that's the ultimate question that has to be answered. Everything else is just ancillary and pieces of data fed into that.

DR. LASSITER: Do you feel that policy findings need to be found in humans first then before we exercise control on tumors found in animals?

this indicates that you cannot readily assess what humans should be exposed to?

DR. BADEN: [illegible] the [illegible] relationship between [illegible] and vinyl chloride but does not at all indicate what an acceptable level would be.

DR. LASSITER: [illegible] human exposure?

DR. BADEN: [illegible]

DR. LASSITER: On that same page, about six lines from the end of [illegible] statement, [illegible] experimental exposures at lower levels in larger numbers of the animal species would produce no tumorigenic results.

Does this indicate that the investigators [illegible] would expect to see more tumors?

MR. BADEN: Well, I think what Dr. Krashner is saying is that -- well, it would be speculative to discuss what would happen.

However, I think the sense of what he is saying is that he would expect a relationship but that this would not in any way help in setting threshold levels.

DR. LASSITER: Does he say, in your opinion, that he expects there to be [illegible] in this [illegible] that he would expect to see this?

DR. BADEN: No.

However, if you did or didn't get tumors, that isn't what is critical in establishing a human level. That you can extrapolate.

DR. LASSITER: That what you are saying in the sentence, sir, I am just asking for the sentence.

I draw from the sentence that he is saying that he would expect tumors at below parts per million if such experiments were done.

Do you agree with that, sir?

MR. CONNOLLY: I think the sentence speaks for itself.

DR. LASSITER: On page 6, in the last paragraph, Dr. Kuschner makes a statement, on the basis of the scientific and medical evidence now available, there is not sufficient knowledge for determining a safe level of VCM exposure to humans.

Do you agree with that sentence?

MR. BADEN: Yes.

MR. CONNOLLY: Dr. Kuschner did not have the Dow Chemical data available at the time of this report.

DR. LASSITER: Would that have altered the -- his conclusion?

MR. CONNOLLY: I wouldn't have the foggiest idea.

DR. LASSITER: On page 65, the statement you made concerning bio-test data, you said man is considerably less susceptible to angiosarcoma than rodents exposed to VCM.

Now, Dr. Schneiderman, in his presentation earlier

[illegible] statistical data is there, and I

[illegible] may interpret [illegible] their own light, but

[illegible] 1,500 [illegible]

[illegible] study,

[illegible] it wasn't

[illegible] 10 years

[illegible] that

[illegible]

[illegible] paragraph.

[illegible]

[illegible] of

the scientific knowledge to date?

[illegible]

MR. [illegible]: Okay.

My final question. Your company represented in its [illegible] that

50 [illegible].

Will your company today modified that

[illegible]

[illegible]

[illegible] I think it was obtained by the fact

[illegible] than we could have brought

between February and now.

We still have blank places, as I said, [illegible] in

our plant [illegible]. It runs over 50 [illegible]

MR. [illegible]: [illegible]

to [illegible] that statement in light of your [illegible].

[illegible] I don't want to correct it. [illegible]

[illegible]

[illegible]

MR. [illegible]: All right, thank you.

JUDGE [illegible]: All right, Mr. [illegible]?

Get this, when you go through a plant like the Pottstown plant of Firestone and you use a Century meter which [illegible] at least [illegible] 8 part background and the highest you find [illegible] in a [illegible] year old plant is 17 ppm, minus 8 background, is 9, then I say there is a huge credibility gap or when you put a personal meter on and walk through, most of the time [illegible] are outside of the plant or when you give into a reactor operator who is not charging any vessels or opening any and getting 2 ppm reading, I would say yes.

There is a misinterpretation in the state of the art.

MR. ROSKIN: Could you tell me what consultation was undertaken with other PVC firms, by either Catalytic, Inc. or by Mr. Higgins about processes which they might employed or which they might employ in the future?

MR. WALKER: I doubt that Mr. Higgins or Catalytic would run a survey through our competitors for this information. It just isn't done.

MR. ROSKIN: So as far as the output time and their conclusions on technical feasibility, their reliance was exclusively on knowledge and proprietary process of Firestone as [illegible] PVC industry data?

MR. WALKER: It was primarily Firestone's. You have to understand Catalytic is building a rather sizeable PVC plant for us right now. They are very expertise.

ek7

MR. RUSKIN: Concerning equipment procurement, did you calculate the length of time before delivery?

MR. WALKER: No. Catalytic provided us that information. That is their business.

MR. RUSKIN: How was the time required for equipment delivery and construction arrived at?

MR. WALKER: I don't know how to answer that once removed. I am not Catalytic.

I assume they use their expertise in the business.

MR. RUSKIN: I have seen reference to the fact that Firestone has planned an expansion of close to 50 million pounds per year, is that correct?

MR. WALKER: That is what I referred to, correct.

MR. RUSKIN: How does the design and engineering specifications of this expansion compare with your current plant and processes?

MR. WALKER: That one I better shy away from.

It is licensed technology that we use. Not Firestone's technology.

MR. RUSKIN: Well, how does this plant expansion compare with the model of the existing plants that Mr. -- well, Mr. Higgins used in calculating those exposure possibilities?

I guess essentially I am asking is there a distinction between your plant expansion in terms of the types of

suggestion from your supplier?

MR. [illegible]: Only a caution that we received. The initial information that we received was that there might possibly be this side effect or bad result from the [illegible] of PVC, so we immediately took every precaution that we could.

We had no knowledge of the danger, but we did everything we could to be on the safe side.

But if -- getting back to the original question -- if we receive material and we have this 25 ppm situation, obviously we could [illegible] live with it. If it's a no detectable level, that puts us out of business. We don't know how we could handle the material that comes in to us with that level.

MR. [illegible]: I take it then you're able to live with the continued 1 PPM requirement -- all of your employees -- presently; is that correct?

MR. [illegible]: That's the way we feel, yes, sir.

MR. [illegible]: Thank you very much.

MR. [illegible]: I have a few very brief questions.

First of all, the information that you received from Goodrich as to the amount of the monomer in the resin, was that in written form or oral form?

MR. [illegible]: It was written.

MR. [illegible]: Could you supply --

MR. [illegible]: Oh, the amount -- pardon me. The amount of -- would you restate the question? I must have --

EXH. 24

TESTIMONY ON THE

PROPOSED STANDARD FOR

VINYL CHLORIDE

- PRESENTED BY -

THE DOW CHEMICAL COMPANY

- AT THE -

PUBLIC HEARING ON VINYL CHLORIDE

OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION

DEPARTMENT OF LABOR

WASHINGTON, D.C.

JUNE 25, 1974

ELEMENTS OF A

COMPREHENSIVE VINYL CHLORIDE

SURVEILLANCE PROGRAM

CONTINUOUS AREA MONITOR

- HISTORY OF CONCENTRATION IN SPECIFIC WORK AREAS

- HISTORY OF EMPLOYEE EXPOSURE

- EARLY WARNING DEVICE

PERSONNEL MONITOR

- DOCUMENTATION OF EXPOSURE

- EVALUATION OF WORK PRACTICES AND ENGINEERING CONTROLS

RLD - SLIDE 1

TABLE I

INDUSTRIAL HYGIENE SURVEYS OF VINYL CHLORIDE

LEVELS IN MONOMER PLANT NO. 1

JOB CLASSIFICATION	TWA, PPM VINYL CHLORIDE		
	1971	1972	1973
A CONTROL - SECTION I	3.7	0.7 (3)	2.1 (2)
C CONTROL - SECTION I	8.2		3.6
A CONTROL - SECTION II	1.8	1.3 (3)	1.0 (3)
B CONTROL - SECTION III	1.1	N.D.*(3)	0.6 (3)
A CONTROL - SECTION IV	6.9	0.6 (3)	8.9 (4)
CLASS I OPERATOR	1.8		
A CONTROL - SECTION V	1.6	0.2 (3)	5.2 (2)
C CONTROL - SECTION V	3.5		3.3
SR. ASST. CHEM. B	5.1	14 (3)	17.6 (2)
SUPERVISION	2.8	1.3 (3)	1.2 (3)
MAINTENANCE		1.7 (3)	2.0 (5)
LOADING OPERATOR		45 (3)	1.1 (3)
OVERALL AVERAGE	3.7 (10)	7.0 (27)	4.2 (29)

( ) NO. OF SAMPLES

*N.D. = NON DETECTED

RLD - SLIDE 2

Table II

Industrial Hygiene Surveys of Vinyl Chloride

Levels in Monomer Plant No. 1

Job Classification	TWA, ppm Vinyl Chloride 1974 1st Qtr	2nd Qtr
A Control - Section I	1.0	4.1
C Control - Section I	5.4	11.5
A Control - Section II	1.8	0.6
B Control - Section III	0.9	0.9
A Control - Section IV	0.4	5.9
Class I Operator	10.8	∠0.1
A Control - Section V	0.7	1.4
C Control - Section V	1.0	---
Sr. Asst. Chem. B	12.7	*
Supervision	2.9 (4)	2.7 (5)
Maintenance	1.7 (4)	2.5 (4)
Loading Operator	16.5 (3)	6.8*
Dev. Lab	0.9 (4)	0.9 (3)
Overall Average	4.4 (24)	1.9 (20)

( ) No. of samples

*Peak Exposure measurements were made for this job.

RLD - SLIDE 3

Table III

INDUSTRIAL HYGIENE SURVEY OF VINYL CHLORIDE

LEVELS IN MONOMER PLANT No. 1

JOB CLASSIFICATION	OPERATION	PEAK EXPOSURE	
		PPM VCM	MINUTES
LOADING OPERATOR	DISCONNECTING TANK CAR*	20.4	5
		26.9	10
		35.9	16
		30.9	6
		161	8
		48.1	7
		26.2	8
		22.9	5
		8.0	9
		5.9	17
		26.8	13
SR. ASST CHEM B	SAMPLING PRODUCT TANK	90.2	10
		59.0	6
		70.4	10.5
		11.7	2.5
		13.9	4
		7.5	3
		7.6	4
		5.7	2
		9.7	5
		0.5	5
		3.8	2

*FRESH AIR MASK WORN

RLD - SLIDE 4

TABLE IV

INDUSTRIAL HYGIENE SURVEYS OF VINYL CHLORIDE

LEVELS IN MONOMER PLANT NO. 2

JOB CLASSIFICATION	TWA, PPM VINYL CHLORIDE 1973	1974
OPERATIONS SPECIALIST	1.5 (2)	1.3 (8)
SR. OP. TECHNICIAN		0.7 (4)
OP. TECHNICIAN	1.2 (2)	2.2 (8)
DAY OPERATIONS	1.2 (2)	0.6 (9)
LAB PERSONNEL	9.5 (3)	4.6 (8)
SHIFT SUPERVISORS	0.4 (2)	1.0 (6)
OFFICE PERSONNEL		0.6 (4)
BOILERMAKER		2.4 (5)
ELECTRICIAN	3.5	4.3 (5)
INSTRUMENT	1.9	1.0 (5)
LABORER	4.5	2.6 (5)
MILLWRIGHT	4.4	1.9 (4)
PIPEFITTER	4.5	4.7 (6)
LOADING OPERATOR	4.2	10.2 (5)
MARINE OPERATOR		1.3 (6)
TANK CAR CLEANER		3.7 (2)
OVERALL AVERAGE	2.2 (17)	2.7 (90)

RLD - SLIDE 5

Table V

Industrial Hygiene Surveys of Vinyl Chloride Levels in Monomer Plant No. 2

Area Monitoring

Sample Period - 4/25/74 - 6/4/74

No. of samples - 499 each location

Location	VCM Concentration, PPM Average	Maximum
Control Room	0.3	7.4
Laboratory	0.4	9.1
Loading Rack	0.4	11+(1)
Product Tanks	0.5	7.2
Furnace Area - 1	0.3	11+(1)
Furnace Area - 2	0.5	11+(1)
Finishing Area - 1	0.3	11+(1)
Finishing Area - 2	0.7	7.5
Finishing Area - 3	0.5	11+(3)
Finishing Area - 4	0.6	11+(3)

( ) No. of samples

RLD - SLIDE 6

TABLE VI

INDUSTRIAL HYGIENE SURVEYS OF VINYL CHLORIDE

LEVELS IN MONOMER PLANT NO. 3

JOB CLASSIFICATION	TWA, PPM VINYL CHLORIDE		
	1973	1974	
		1ST QTR	2ND QTR
REACTOR TECHN - 1	1.0	∠0.1 (3)	6.4
REACTOR TECHN - 2	N.D.*	0.1 (2)	0.5 (2)
REACTOR TECHN - 3	0.1	0.4	0.1
DISTN. TECHN	∠ 0.1	0.8 (2)	3.4 (4)
CONTROL CTR TECHN	---	0.4	------
LAB TECHN	10.4	6.1 (2)	7.4 (3)
LOADING TECHN	2.1	12.3 (5)	6.3
REPAIR TECHN	0.1	∠0.1	0.4 (7)
SUPERVISION	N.D.*	------	0.3
SERVICES TECHN	----	------	0.9
OVERALL AVERAGE	1.7 (8)	1.2 (17)	1.2 (21)

(   ) NO. OF SAMPLES

*N.D. = NONE DETECTED

RLD - SLIDE 7

TABLE VII

INDUSTRIAL HYGIENE SURVEYS OF VINYL CHLORIDE

LEVELS IN MONOMER PLANT NO. 3

JOB CLASSIFICATION	OPERATION	PEAK EXPOSURE PPM VCM	PEAK EXPOSURE MINUTES
DISTN. TECHN	EQUIPMENT SURVEILLANCE	.6	10
		2.3	10
		.3	10
		.6	10
REACTOR TECHN - 1	EQUIPMENT SURVEILLANCE	.3	10
		.3	10
LOADING TECHN	DISCONNECTING TANK CAR*	13.3	10
LAB TECHN	SAMPLE ANALYSIS	24.6	10
REPAIR TECHN	OPENING EQUIPMENT	1.1	10
		1.0	10

*FRESH AIR MASK WORN

RLD - SLIDE 8

Production Unit No. 1

Vinyl Chloride*

Job Classification	TWA 8 hr. in ppm 1950-1959	Excursions ppm
Dry-end Operations		
Foreman	5	
Shipping Clerk	5 - 10	
Utility	5 - 10	
Packer	5 - 10	
Ass't Op.	5 - 10	
Shift Miller	5 - 10	
Wet-end Operations		
Foreman	10 - 50	2000 - 4000
Crew leader	10 - 50	2000 - 4000
Mechanic	50	2000 - 4000
Polymer Ass't Op	120 - 385	2000 - 4000
Class 1 Op.	120 - 385	2000 - 4000
Class 2 Op.	120 - 385	2000 - 4000
Alternate	120 - 385	2000 - 4000
Spare	120 - 385	2000 - 4000
Dryer Op.	95 - 350	2000 - 4000
Monomer Still Op.	50 - 85	2000 - 4000
Flash Dryer Op.	15 - 100	2000 - 4000
Tankcar Unloader	100	2000 - 4000
Monomer Transfer Op.	100	2000 - 4000

*Continuous analyzer, total halogen calculated as vinyl chloride.

RLD - SLIDE 9

Production Unit No. 1

Vinyl Chloride*

Job Classification	8 hr. TWA in ppm 1960-1963	Excursions ppm
Dry-end Operations		
Foreman	5	
Shipping Clerk	5	
Utility	5	
Packer	5	
Ass't Op.	5	
Shift Miller	5	
Wet-end Operations		
Foreman	10	
Crew leader	10	
Mechanic	25	
Polymer Ass't Op.	25 - 80	500
Class 1 Op.	25 - 80	500
Class 2 Op.	25 - 80	500
Dryer Op.	25 - 85	
Monomer Still Op.	25 - 45	
Flash Dryer Op.	10 - 15	
Tankcar Unloader	25	
Monomer Transfer Op.	25	

*Continuous analyzer, total halogen calculated as Vinyl Chloride.

RLD - SLIDE 10

AIR ANALYSIS REPORT - : COPOLYMER PLANT - 564 BLDG - VINYL CHLORIDE
PRINTED 6/10/74 AT 811 HRS. (DATA IS FOR DAY ENDING AT 0800 HRS.)

SAMPLE LOCATION SUMMARY BY SHIFT IN PPM VCL

	MIDNIGHT				DAY				AFTERNOON			
LOC.	NO.	AVG.	MAX.	TIME	NO.	AVG.	MAX.	TIME	NO.	AVG.	MAX.	TIME
1	79	2.0	3.	408	78	2.0	2.	802	80	2.1	4.	2114
2	79	2.2	7.	621	77	2.0	4.	1239	80	2.6	16.	2109
3	50	2.0	2.	3	54	1.9	2.	802	47	1.9	2.	1603
4	79	2.0	2.	3	79	1.9	2.	802	80	2.0	2.	1603
5	79	2.5	16.	744	77	2.7	12.	1045	80	2.4	6.	2039
6	79	2.0	2.	4	78	1.9	2.	803	80	2.0	2.	1604
7	61	2.0	3.	422	55	2.0	3.	1046	64	2.3	6.	1646
8	78	2.1	4.	440	76	2.2	8.	1134	79	4.2	86.	1710
9	79	3.5	9.	727	77	3.3	26.	1046	79	4.2	8.	2028
10	79	1.9	2.	5	79	1.9	2.	805	80	1.9	2.	1605
11	79	2.2	3.	341	78	2.0	3.	805	80	2.6	5	1905
12	79	3.1	5.	411	78	2.4	5.	1529	80	3.2	7.	2011
13	78	2.0	3.	411	78	2.7	15.	1205	80	2.3	3.	1647
14	73	2.6	3.	18	76	4.8	17.	1218	76	3.5	6.	1606
15	71	2.7	4.	642	70	13.4	196.	1200	74	3.9	8.	2230
16	77	2.9	4.	306	77	4.0	13.	848	80	3.4	10.	1712
17	78	3.1	5.	400	77	4.7	31.	848	79	3.9	15.	1712
18	58	3.5	12.	13	64	5.0	18.	955	58	4.8	20.	2237

RLD - SLIDE 11

AIR ANALYSIS REPORT - COPOLYMER FLANT - 564 BLDG - VINYL CHLORIDE
PRINTED 6/10/74 AT 810 HRS. (DATA IS FOR DAY ENDING AT 0800 HRS.)

565 LOADING OPER - TIME WEIGHTED AVE. EXPOSURE DISTRIBUTION (*SEE NOTE)

PPM VCL	PCT-MIDNIGHT (4)	PCT-DAY (2)	PCT-AFTERNOON (3)
0. - 5.	100-************	100-************	99-************
5. - 10.	0-	0-	1-
10. - 25.	0-	0-	0-
25. - 50.	0-	0-	0-
50. - 100.	0-	0-	0-
100. - 200.	0-	0-	0-
ABOVE 200.	0-	0-	0-
AVERAGE	2.0 PPM VCL	2.0 PPM VCL	2.2 PPM VCL

565 PUMPING OPER - TIME WEIGHTED AVE. EXPOSURE DISTRIBUTION (*SEE NOTE)

PPM VCL	PCT-MIDNIGHT (4)	PCT-DAY (2)	PCT-AFTERNOON (3)
0. - 5.	100-************	99-************	100-************
5. - 10.	0-	1-	0-
10. - 25.	0-	0-	0-
25. - 50.	0-	0-	0-
50. - 100.	0-	0-	0-
100. - 200.	0-	0-	0-
ABOVE 200.	0-	0-	0-
AVERAGE	2.1 PPM VCL	2.1 PPM VCL	2.3 PPM VCL

564 DRYER OPER. - TIME WEIGHTED AVE. EXPOSURE DISTRIBUTION (*SEE NOTE)

PPM VCL	PCT-MIDNIGHT (4)	PCT-DAY (2)	PCT-AFTERNOON (3)
0. - 5.	100-************	100-************	100-************
5. - 10.	0-	0-	0-
10. - 25.	0-	0-	0-
25. - 50.	0-	0-	0-
50. - 100.	0-	0-	0-
100. - 200.	0-	0-	0-
ABOVE 200.	0-	0-	0-
AVERAGE	0.0 PPM VCL	0.0 PPM VCL	0.0 PPM VCL

591 POLYMER OPER - TIME WEIGHTED AVE. EXPOSURE DISTRIBUTION (*SEE NOTE)

PPM VCL	PCT-MIDNIGHT (4)	PCT-DAY (2)	PCT-AFTERNOON (3)
0. - 5.	100-************	81-************	100-************
5. - 10.	0-	8-**	0-
10. - 25.	0-	9-**	0-
25. - 50.	0-	3-*	0-
50. - 100.	0-	0-	0-
100. - 200.	0-	0-	0-
ABOVE 200.	0-	0-	0-
AVERAGE	2.1 PPM VCL	5.1 PPM VCL	2.7 PPM VCL

*NOTE- THESE ARE THE TIME WEIGHTED AVERAGE EXPOSURES ASSUMING THE OPERATOR IN QUESTION WAS IN THE SAMPLED AREAS THE PREDESIGNATED AMOUNT OF TIME AND DID NOT WEAR AUXILIARY RESPIRATORY EQUIPMENT.

RLD - SLIDE 12

VINYL CHLORIDE

CONTINUOUS AREA SAMPLING BY SHIFT

EIGHT HOUR TWA IN PPM

JOB CLASS	MONTH	MID	DAY	PM
DRYER OPR	FEB	0.4	0.5	0.4
	MAR	0.1	0.1	0.1
	APR	0.1	0.1	0.1
	MAY	-	-	-
POLYMER OPR	FEB	10.2	11.9	10.5
	MAR	3.7	3.2	3.0
	APR	4.9	4.2	4.3
	MAY	3.3	3.1	3.1
LOADER OPR	FEB	10.1	11.5	10.0
	MAR	4.3	3.5	7.7
	APR	4.9	4.5	5.2
	MAY	3.4	3.2	3.3
PUMPER OPR	FEB	14.5	15.2	14.9
	MAR	6.4	4.5	4.8
	APR	5.1	4.9	6.2
	MAY	3.9	3.6	3.7

RLD - SLIDE 13

VINYL CHLORIDE

PERSONNEL MONITORING

DRIER OPERATOR (EMULSION)	DATE	EIGHT HOUR TWA PPM
	3-26-74	8.3
	3-29-74	13.0
	3-30-74	1.1
	4-12-74	2.6
	4-17-74	5.6
DRIER OPERATOR (SUSPENSION)		
	3-28-74	6.4
	4-2-74	3.2
	4-12-74	4.9
	4-18-74	5.9

RLD - SLIDE 14

VINYL CHLORIDE

PERSONNEL MONITORING

PACKAGER (EMULSION)	DATE	EIGHT HOUR TWA PPM
	3-15-74	0.2
	3-28-74	0.8
	4-2-74	7.5
PACKAGER (SUSPENSION)		
	3-14-74	0.3
	3-30-74	1.2
	4-4-74	2.5
	4-18-74	5.6

RLD - SLIDE 15

EMULSION PRODUCTION UNIT

FALL 1973

SPOT AREA SAMPLES FOR ENGINEERING STUDIES

AREA	MINUTES	VINYL CHLORIDE PPM
PREMIX TANK FILLING	27	5.2
PREMIX TANK FILLING	30	2.4
REACTOR AREA, TRANSFERRING	25	0.5
REACTOR AREA, FILLING (LEAKING FILTER)	5	4.0
REACTOR AREA, AFTER FILLING	30	19.0
REACTOR AREA FILLING	15	26
CONTROL ROOM	30	0.0
COMPRESSOR AREA VALVE CHANGE	10	4.5
COMPRESSOR AREA, NORMAL	30	0.4
COAGULATOR ROOM	30	3.8
COAGULATOR ROOM	30	0.7
FILTER, STEAMJET POT, DRAINING	8	1100
FILTER, STEAMJET, NORMAL	14	5
FILTER DRAINING	10	<0.3
DRAIN SUMP, FINISHING JETS	25	<0.1
DRAIN SUMP, FINISHING JETS	30	0.6
BRINE DRAINING	4	2200

RLD - SLIDE 16

EMULSION PRODUCTION UNIT

FALL 1973

PERSONNEL MONITORING SAMPLES FOR WORK PRACTICE STUDIES

JOB ASSIGNMENT	MINUTES	VINYL CHLORIDE PPM
CHANGE FILTER SOCK	10	1.7
CHANGE FILTER SOCK	10	68
CLEAN COAGULATOR TANK	30	2.9
WASHING REACTOR	10	9.5
REACTOR WASHOUT	9	5.6
REACTOR WASHOUT	5	96
REACTOR WASHOUT	8	120
REPLACE COMPRESSOR SAFETY VALVE	5	7.4
DUMPING STILL BOTTOMS	30	<0.1
SAMPLE COLLECTION	3	<2
SAMPLE ANALYSIS	6	<0.4
BRINE DRAINING	4	1800

RLD- Slide 17

VINYL CHLORIDE

REACTOR OPERATOR

DATE	PERSONNEL MONITORING EIGHT HOUR TWA PPM	AREA MONITORING EIGHT HOUR TWA PPM	AREA MONITORING MAX OBSERVED READING PPM
3-26-74	7.6	4.6	7.2
3-28-74	5.1	3.6	4.1
4-11-74	11.0	5.1	20.0
4-17-74	8.6	*	*
5-30-74	4.4	2.0	4.0
6-17-74	4.1	1.0	14.0

*ANALYZER DOWN

RLD - SLIDE 18

EXHIBIT C

4. Where questions of scientific judgment are challenged there should be ample provision for review by scientific committees nominated by the National Academy of Sciences.

5. The Administrator must recognize that agriculture is part of the total environment with which he is concerned.

6. The legislation must guard against legislative and administrative controls so restrictive that there is insufficient incentive for the chemical industry to continue with the research and development that is so essential to meet the critical pesticide needs of the future.

Legislation to carry out the intent of these points, in our judgment, is essential to protect the total public interest and achieve the kind of environment in which we want to live and work.

Mr. Chairman, if I could make just one comment about a report known as the Report of the Secretary's Commission on Pesticides and their Relationship to Environmental Health. Mr. Mrak is the chairman.

A number of witnesses, including those from the administration, have quoted from this report to substantiate the damage pesticides are doing to the environment. This report has a total of 14 official recommendations of the Commission. These official recommendations are the only part of this report agreed to by all of the members of the Commission; and they are found on pages 7 through 19 of the document report "Secretary's Commission on Pesticides and Their Relationship to Environmental Health, Parts I and II."

The remainder of this volume, Mr. Chairman, page 19 through page 7, includes the subcommittee reports. Mr. Mrak's committee has never reached any conclusion on the subcommittee reports.

Actually, from all of the witnesses you have heard, there is a great variation in scientific judgments on many of these matters. You can pick parts of the subcommittee report and substantiate virtually any position that you could take. But I would submit that it might be important for those studying the record and developing the legislation, to recognize that only the 14 specific recommendations have been agreed to by the membership of the Commission.

That concludes my comments.

Senator ALLEN. Thank you, Mr. Lerch and Mr. Stokes. I don't believe I have any questions to ask and we do appreciate your appearing before the committee and giving us the benefit of your views.

Mr. LERCH. Thank you.

Mr. STOKES. Thank you.

Senator ALLEN. I have a meeting of the Rules Committee subcommittee at 1 o'clock. It is around the corner and down the hall. So I can stay until about 2 minutes to 1, at which time we will recess until o'clock. So if you would proceed, Dr. Saffiotti.

STATEMENT OF DR. UMBERTO SAFFIOTTI, ASSOCIATE SCIENTIFIC DIRECTOR FOR CARCINOGENESIS, NATIONAL CANCER INSTITUTE, NATIONAL INSTITUTES OF HEALTH, BETHESDA, MD.

Dr. SAFFIOTTI. My name is Umberto Saffiotti, M.D., and I am associate scientific director for Carcinogenesis, National Cancer Institute, National Institutes of Health.

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I am glad to have the opportunity to present my testimony on the problem of the evaluation of carcinogenic effects of pesticides.

The National Cancer Institute has committed a major effort to this problem, beginning in 1964, following the recommendations contained in the 1963 report on the "Use of Pesticides" prepared by the President's Science Advisory Committee. A large bioassay screening program for pesticides and other industrial chemicals was organized, using standardized test conditions and was conducted under contract at Bionetics Research Laboratories. It represented the first example of a large-scale screening program of this kind ever to be implemented. The results of the carcinogenesis tests were published in the Journal of the National Cancer Institute [42: 1101-1114, 1969].

A second level testing project on pesticides is now underway in the NCI carcinogenesis program through several contracts. This includes more extensive bioassays in rats and mice. These tests are conducted not only to detect hazardous environmental chemicals, but also to provide necessary information for the scientific evaluation of the mode of action of environmental carcinogens and preventability.

The problems of evaluating carcinogenic hazards from environmental chemicals in general, and from pesticides in particular, have been the subject of two recent reports.

The first report was prepared for the Surgeon General, U.S. Public Health Service, by an ad hoc committee on the Evaluation of Low Levels of Environmental Chemical Carcinogens which was established at the National Cancer Institute and composed of distinguished scientists in the field of enviromental cancer. I served as Chairman of the Committee.

Publication of this report has been authorized by the Surgeon General, and the report has been submitted for consideration to the editorial board of the Journal of the National Cancer Institute for publication in that scientific journal.

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The report discusses the major problems involved in the evaluation of carcinogenic risks, and therefore is directly relevant to the subject of the present hearings.

If agreeable to the subcommittee, I will submit the complete text of this report for the record.

Senator ALLEN. That will be accepted.

(The report referred to follows:)

EVALUATION OF ENVIRONMENTAL CARCINOGENS—REPORT TO THE SURGEON GENERAL, USPHS, APRIL 22, 1970

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(Ad Hoc Committee on the Evaluation of Low Levels of Environmental Chemical Carcinogens, National Cancer Institute, Bethesda, Md.)

MEMBERS OF THE AD HOC COMMITTEE ON THE EVALUATION OF LOW LEVELS OF ENVIRONMENTAL CHEMICAL CARCINOGENS

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INTRODUCTION

Establishment of this Ad Hoc Committee was requested on October 24, 1969, by the Deputy Assistant Secretary for Health and Scientific Affairs.

The task of the Committee is to review the problems relating to the evaluation of low levels of environmental chemical carcinogens, to consider the scientific bases on which such evaluations can be made, and to advise the Department of HEW on the implications of such evaluations.

The Committee, in addressing itself to the problems of environmental exposures to chemical agents from all sources, has considered the scientific criteria for evaluation of carcinogenic hazards.

Many previous recommendations on the criteria to be used for evaluating environmental chemical carcinogenic hazards have been made for specific sources of exposure or for specific groups of substances (e.g. food additives, pesticides, certain occupational carcinogens). In some cases this approach has led to an uneven assessment of risks from different sources and to an uneven approach to preventive measures.

The task of this Committee covers a broader area and includes an appraisal of the scientific criteria for evaluation of chemical carcinogenesis hazards in the total environment.

I. RECOMMENDATIONS

In full consideration of the past and present states of carcinogenesis investigation this Committee offers the following recommendations:

1.a. Any substance which is shown conclusively to cause tumors in animals should be considered carcinogenic and therefore a potential cancer hazard for man. Exceptions should be considered only where the carcinogenic effect is clearly shown to result from physical, rather than chemical, induction, or where the route of administration is shown to be grossly inappropriate in terms of conceivable human exposure.

b. Data on carcinogenic effects in man are only acceptable when they represent critically evaluated results of adequately conducted epidemiologic studies.

2. No level of exposure to a chemical carcinogen should be considered toxicologically insignificant for man. For carcinogenic agents a "safe level for man" cannot be established by application of our present knowledge. The concept of "socially acceptable risk" represents a more realistic notion.

3. The statement made in 1969 by the Food Protection Committee, National Research Council (see Appendix II) that natural or synthetic substances can be considered safe without undergoing biological assay should be recognized as scientifically unacceptable.

4. No chemical substance should be assumed safe for human consumption without proper negative lifetime biological assays of adequate size. The minimum requirements for carcinogenesis bioassays should provide for: adequate numbers of animals of at least two species and both sexes with adequate controls, subjected for their lifetime to the administration of a suitable dose range, including the highest tolerated dose, of the test material by routes of administration that include those by which man is exposed. Adequate documentation of the test conditions and pathologic standards employed are essential.

5. Evidence of negative results, under the conditions of the test used, should be considered superseded by positive findings in other tests. Evidence of positive results should remain definitive, unless and until new evidence conclusively proves that the prior results were not causally related to the exposure.

6. The implication of potential carcinogenicity should be drawn both from tests resulting in the induction of benign tumors and those resulting in tumors which are more obviously malignant.

7. The principle of a zero tolerance for carcinogenic exposures should be retained in all areas of legislation presently covered by it and should be extended to cover other exposures as well. Only in the cases where contamination of an environmental source by a carcinogen has been proven to be unavoidable should exception be made to the principle of zero tolerance. Exceptions should be made only after the most extraordinary justification, including extensive documentation of chemical and biological analyses and a specific statement of the estimated risk for man, are presented. All efforts should be made to reduce the level of contamination to the minimum. Periodic review of the degree of contamination and the estimated risk should be made mandatory. 181

8. A basic distinction should be made between intentional and unintentional exposures.

a. No substance developed primarily for uses involving exposure to man should be allowed for wide-spread human intake without having been properly tested for carcinogenicity and found negative.

b. Any substance developed for use not primarily involving exposure to man but nevertheless resulting in such exposure, if found to be carcinogenic, should be either prevented from entering the environment or, if it already exists in the environment, progressively eliminated.

9. A system should be established for ensuring that bioassay operations providing data upon which regulatory decisions are made be monitored so that their results are obtained in accordance with scientifically acceptable standards.

10. A unified approach to the assessment and prevention of carcinogenesis risks should be developed in the federal legislation; it should deal with all sources of human exposure to carcinogenic hazards.

11. Clear channels should be identified for the regulatory function of different Government departments and agencies in the field of cancer prevention. Establishment of a surveillance and information program would alert all concerned Government agencies to the extent and development of information on formation on carcinogenic hazards.

12. An ad hoc committee of experts should be charged with the task of recommending methodos for extrapolating dose-response bioassay data to the low response region (1-10000% to 1-100000000%). The low doses corresponding to the responses in this range are the ones which have direct relevance to the human situation.

II. BACKGROUND

Knowledge of cancer causation by chemicals originates from clinical observations, going back as far as 1775 with Pott's discovery of soot as the causative agent in chimney sweeps' cancer. Several major classes of carcinogenic agents were first discovered by their effects on man. Experimental animal models for the determination of the potential carcinogenic activity of chemicals were only developed in the last 50 years, and most of them have been studied only in the last 20 years.

The effects of carcinogens on tissues appear irreversible. Exposure to small doses of a carcinogen over a period of time results in a summation or potentiation of effects. The fundamental characteristic which distinguishes the carcinogenic effect from other toxic effects is that the tissues affected do not seem to return to their normal condition. This summation of effects in time and the long interval (latent period) which passes after tumor induction before the tumor becomes clinically manifest demonstrate that cancer can develop in man and in animals long after the causative agent has been in contact and disappeared.

It is, therefore, important to realize that incidences of cancer in man today reflect exposure of 15 or more years ago; similarly, any increase of carcinogenic contaminants in man's environment today will reveal its carcinogenic effect some 15 or more years from now. For this reason it is urgent that every effort be made to detect and control sources of carcinogenic contamination of the environment well before damaging effects become evident in man. Similar concepts may apply to the needs for evaluation of other chronic toxicity hazards. Environmental cancer remains one of the major disease problems of modern man.

An agent which is causally related to the occurrence of cancer in man or animals is defined as a carcinogen or oncogen. The number of known carcinogenic agents includes several groups of viruses, various physical factors, and hundreds of chemicals.

Viruses of different types are known to induce cancer in animals; none has yet been proven to evoke cancer in man. If specific viruses are proven to be causally 182

related to cancer induction in man, the frequency of certain human tumors might be reduced in the future by immunization procedures.

Physical factors are known to cause cancers in man and animals. For example, ultraviolet radiation causes skin cancer, and ionizing radiation cancer of various organs (e.g. leukemias, lung cancer, bone sarcomas, skin cancer). Exposure to a "background level" has been widely considered as unavoidable and, in the case of ultraviolet light, even necessary as an integral part of our natural environment. Strong epidemiologic and experimental evidence indicates the existence of a direct dose-response relationship between exposure to radiation and carcinogenic effects. Tolerance levels have been suggested for various forms of radiation and health benefits have been realized from their application. Evaluation of radiation hazards has been approached through measurement of the total cumulative dose of radiation exposure. Some carcinogenic radiation hazards, such as certain occupational exposures (e.g. radiation in uranium mines), are still not effectively controlled.

Chemicals of many classes produce cancer in a large number of organ sites in animals. Cancers in man are known to be caused by several individual chemicals and by materials composed of mixtures of chemicals. Chemical carcinogens have been shown to act by surface contact with skin or mucosae, by inhalation, by ingestion, and occasionally by injection or implantation (medical or accidental). Chemicals may induce cancer at the site of initial contact (e.g. skin cancer from radionuclides), the site of metabolism and detoxification (e.g. liver or kidney cancer from aflatoxin or nitrosamines), or the site of excretion (e.g. urinary polynuclear hydrocarbons), the site of selective localization (e.g. bone cancer bladder cancer from aromatic amines). A complex and often uneven approach to the problem of preventing exposure to chemical carcinogens has developed over the years. It has become increasingly obvious that the hazard from a single chemical carcinogen cannot be evaluated out of context of the total environmental exposure (V). Estimation of the "cumulative carcinogenic dose" resulting from all possible chemical carcinogens or even from all sources of a single type or class of chemical carcinogens is presently impossible.

Prevention of exposure to known carcinogenic chemicals depends largely on man's ability to control their entry into the environment. Certain chemical carcinogens are natural products (e.g. metabolites of the amino acid tryptophan) or naturally occurring contaminants (e.g. mycotoxins). Others are formed in the processing of natural products. Many, such as polynuclear hydrocarbons (e.g. benzo[a]pyrene), occur almost ubiquitously in our modern industrialized environment. They derive from most sources of organic combustion. A class of very potent carcinogens discovered only in recent years, the N-nitrosamines, include compounds that may be formed in the environment from nitrites and secondary amines. Many other known chemical carcinogens have been introduced as synthetic materials or by-products into man's present environment through a wide range of newly developed industrial processes. Some of these, such as food additives, medicinal products, cosmetics, and certain household products or pesticides, were developed for human use. Several carcinogens derive from products such as tobacco smoke, developed exclusively for human use. In other cases chemical carcinogens not intended primarily for human exposure are introduced into the general environment and eventually come in contact with its inhabitants; many substances (certain polynuclear hydrocarbons, pesticides, metals, dusts, and gases, etc.) gain widespread environmental distribution, thereby becoming pollutants of the air, soil, water, and food. Prevention of exposure to this broad spectrum of chemical carcinogens must take a variety of forms.

The production of chemicals recognized as carcinogens for uses involving intentional human exposure can be identified and effectively eliminated. Exceptions to this approach should be made for substances that involve a well-defined health benefit (e.g. certain chemotherapeutic drugs). Use of such substances should be accepted on the basis of extraordinary evidence that their health benefit outweighs their risk.

The production of specific carcinogenic chemicals for uses that do not primarily involve an intentional exposure of man, but which result in such environmental contamination that extensive human exposure becomes inevitable, must also be controlled. The most effective prevention of exposure in man is the elimination of carcinogen production, or control of entry into the environment. A large group of chemical carcinogens (e.g. combustion products, mycotoxins, and other natural products) is widely disseminated in the environment from sources that can only be partly controlled. For these contaminants, as

well as for products which have been widely spread in the environment before their carcinogenicity was recognized, the only possible approach to exposure reduction is to monitor their environmental distribution and subsequently minimize their contact with humans.

Modifying factors are known to condition the development of neoplasia in man and animals. They can act intrinsically or extrinsically (e.g. hormonal imbalances, metabolic characteristics or abnormalities, caloric intake, dietary factors). Understanding of their specific effects in man, however, is still not adequate to serve as a reliable basis for preventative action.

Interactions among multiple factors have received limited attention to date. There are well-documented instances in animal studies of strong synergistic effects produced by chemicals in combination with radiation, viruses, or other chemicals. The epidemiological patterns of certain human cancers implicate combined effects of multiple agents (e.g. inhalation of radon and radon daughters in uranium mines and cigarette smoking).

The types of cancer in man that are due, directly or indirectly, to extrinsic factors are thought to account for a large percentage of the total cancer incidence (2). These include tumors of the skin, the respiratory, gastrointestinal and urinary tracts, hormone-dependent organs (such as the breast, thyroid, and uterus), and the hemopoietic system. During the past decade considerable progress has been made in the detection of carcinogenic agents and the analysis of their biological effects. New approaches to the interpretation of quantitative relationships between exposures and carcinogenic effects in man and animals are being developed. It is estimated, therefore, that the majority of human cancers are potentially preventable (2).

III. ANIMAL BIOASSAY RESULTS AND EVALUATION OF RISKS IN MAN

In order to evaluate the hazard of a chemical for man, one must extrapolate from the animal evidence. It is essential to recognize that no level of exposure to a carcinogenic substance, however low it may be, can be established to be a "safe level" for man. This concept, put forward in the 1950's, remains true in 1970. The current legislation in the field of food additives, with its "anticancer clause", is based on this principle (Federal Food, Drug and Cosmetic Act, as amended, Sect. 409 (c) (3) (A)).

The reasons for retaining this "anticancer clause" were effectively summarized in 1960 by Secretary of Health, Education and Welfare Arthur S. Flemming in testimony to Congress (3) on the subject of extending the clause to cover the use of food colors, with the following statement.

"The rallying point against the anticancer provision is the catch phrase that it takes away the scientist's right to exercise judgment. The issue thus made is a false one, because the clause allows the exercise of all the judgment that can safely be exercised on the basis of our present knowledge. The clause is grounded on the scientific fact of life that no one, at this time, can tell us how to establish for man a safe tolerance for a cancer-producing agent.

"Until cancer research makes a breakthrough at this point, there simply is no specific basis on which judgment or discretion could be exercised in tolerating a small amount of a known carcinogenic color on food additive.

"As I pointed out in my original testimony, the opposition to inclusion of an anticancer clause arises largely out of a misunderstanding of how this provision works. It allows the Department and its scientific people full discretion and judgment in deciding whether a substance has been shown to produce cancer when added to the diet of test animals. But once this decision is made, the limits of judgment have been reached and there is no reliable basis on which discretion could be exercised in determining a safe threshold dose for the established carcinogen.

"So long as the outstanding experts in the National Cancer Institute and the Food and Drug Administration tell us that they do not know how to establish with any assurance at all a safe dose in man's food for a cancer-producing substance, the principle in the anticancer clause is sound.

"I want to emphasize the statement I made on January 26 that the Food, Drug, and Cosmetic Act, as it now stands, will be enforced to prohibit the addition of cancer-producing substances to food unless a law should be passed directing us to follow another course of action.

"Even though we have this authority in the law, we urge the Congress to

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n with the executive branch to give added assurance to the consuming public directing the anticancer clause in the proposed color additives amendment. "Again, we say, however, that we believe the issue is so important that the ected Representatives of the people should have the opportunity of examining e evidence and determining whether or not the authority should be granted." The scientific basis on which the Government's position was established in 60 remains valid. The progress of knowledge in carcinogenesis in the last ecades has only strengthened the points made in Secretary Flemming's testiony.

IV. DETECTION OF LOW LEVELS OF CARCINOGENS IN THE ENVIRONMENT

To establish the presence of "low levels of carcinogen in the environment" quires that 1) the presence of the material in question be recognized in the environment and 2) the material be recognized as carcinogenic. To evaluate the pact of a chemical in the human environment, it is useful to prepare an "environmental profile" to reflect the distribution of this material in time and space. ailure to detect the presence of a compound implies only that the compound present, if at all, in concentrations below the detectable limit of the analytical ethod used. These "sub-detection levels" cannot be differentiated from "zero". rom the distribution profile and additional information on the conditions of take in man the approximate level and extent of exposure for population segents can be estimated.

In recognizing a chemical as a carcinogen, the limiting factor is the sensitivity and specificity of the bioassay system used. A bioassay system designed to tect tumor induction only at or above a given level under the conditions of the st (e.g. a 25% incidence of a specific tumor type) will fail to reveal carinogenicity below that level. Compounds whose carcinogenic effects fall below ecific bioassay detection limits must not be considered innocuous. Such mateals must be characterized as presenting a carcinogenic risk no greater than at defined by this lower limit.

Methodology for the determination of chemical contamination in the environent and of biological activity of carcinogens are discussed in the following ctions.

Chemical Detection Methods

Methods for detection of low levels of carcinogens in the environment have ineased in accuracy and reliability over the past several years. The lower limits detection for different types of known carcinogenic substances are extremely riable, extending over several orders of magnitude from very sensitive methods .g. 1 part per billion of benzo(a)pyrene or aflatoxin) to rather insensitive ones .g. for aromatic amines). In principle, analytical methods should be capable of tecting carcinogenic materials at any level or in any condition which has releance to human exposure. For this reason, increasingly sensitive analytical techiques are needed, and indeed many have been developed over the last 10 years. ppendix 1 summarizes the present state of the art in the analytical determinaon of low levels of environmental carcinogens (*1*) and indicates the lower limits detection available today, in contrast with those of 1959. Much of the improveent in methodology is attributable to the application of gas-liquid chromatoraphic techniques. Within the next few years sizable additional improvements the sensitivity of analytical methods are likely to be achieved.

It is important to consider how widely the new analytical methods can be pplied for the detection of a given carcinogenic contaminant in different mateals. While highly sensitive analytical methods can be devised to detect a chemial in specific materials, these same methods might be powerless in the analysis of he same chemical from other source materials (e.g. dimethylnitrosamine can be etected in the alcoholic beverages at 1 ppb, but in foods only at 10-100 ppb). An neven evaluation of the sources of environmental contamination may result. Deelopment of widely applicable procedures will provide a more balanced evaluaion of environmental contamination.

B. Biological Detection Methods

The carcinogenic activity of materials can only be detected by long-term biogical tests. At the present time the chemical structure or physico-chemical roperties of a compound do not provide a reliable basis for prediction of freeom from carcinogenic activity. Several structure-activity correlations are valuble indicators of the possible carcinogenicity of a compound, but none can be

used to classify the compound as non-carcinogenic. Short-term bioassays that determine the effect of certain chemicals on selected biologic targets have not been reliable for prediction of carcinogenic activity.

The present state of the art requires long-term bioassays in mammalian species for the experimental identification of carcinogenic activity. United States law requires that food additives and various other materials be tested in animals by the intended route of human exposure. Similar tests have not been required for some materials to which humans are exposed by other than the oral route. The expanding production and use of chemicals in household products results in extensive human exposure (via the skin and respiratory tract) to dusts and aerosols; little information is available on the chronic toxicity of these materials by these routes of administration. It would not be wise to wait for the results of these "experiments in man" before instituting animal experimentation.

Bioassays are always performed on a number of animals which is extremely small when compared with the millions of humans exposed to most environmental carcinogens. Such studies can only detect carcinogenic effects resulting in fairly high incidences. For example, an observed outcome of no tumors in a test group of 100 animals, as well as in 100 negative controls, only provides assurance, at the 99 percent probability level, that the true tumor risk is under 4.5 percent. The maximum probable risk is 0.46 percent if groups of 1000 animals are used. It would require tumor-free results in 450 animals to establish with like probability that the risk is under 1 percent (4).

The assessment of the carcinogenic activity of a chemical depends on a variety of parameters. These include not only the total number of tumors induced but also their multiplicity, latent period, morphologic type, and degree of malignancy. The induction of tumors diagnosed as benign as a result of treatments has been interpreted by certain groups in the past as not sufficient to demonstrate a "carcinogenic" effect. This is a dangerous position since few, if any, substances are known to have produced only benign tumors and no malignant ones when properly and repeatedly tested. This has been pointed out in the Report of the Subcommittee on Carcinogenesis of the FDA Committee on Protocols for Safety Evaluation (5).

The important scientific problem of defining the sensitivity of a bioassay system used for testing materials of unknown activity has received insufficient attention. The interpretation of both positive and negative findings is strictly dependent on such definition as well as on the results obtained in negative, vehicle, positive and colony control animals. A bioassay result is meaningful only when accompanied by a statement of the sensitivity and specificity of the bioassay design used. An observed incidence of a given tumor type in a test group has no meaning without adequate information on the appropriate controls. Far too little work has been done using adequate positive controls. Lack of tumor response in a given experimental system cannot be interpreted as negative evidence if positive controls also yield negative results or if no positive controls have been included to show that the experimental system used is appropriate.

A body of knowledge has developed over the years on the response of experimental animals to chemical carcinogens. Several committees of experts in the field of carcinogenesis convened by national and international bodies over the past 15 years have formulated general principles for performance and evaluation of carcinogenesis studies in animals. The recommendations put forth by these committees have shown remarkable unanimity (2, 5–10) and are widely accepted in principle by the scientific community (11–15). General requirements for testing procedures, which have been outlined by these groups, include specification of criteria for the following:

1. selection of materials to be tested;
2. chemical and physical characterization of the test materials;
3. selection of appropriate animal species and group size; and
4. choice of appropriate routes and levels of administration.

In addition, recommendations concerning the lifetime maintenance and pathological examination of experimental animals have been outlined.

Two principles are recognized as fundamental to the evaluation of carcinogenesis bioassays.

1. The minimum requirements for carcinogenesis bioassay should include adequate numbers of animals of at least two species and both sexes with adequate positive and negative controls, subjected for their lifetime to the

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administration by appropriate routes of a suitable dose range of the test material, including doses considerably higher than those anticipated for human exposure.

2. Any substance which is shown conclusively to produce tumors in animals, when tested under these conditions, should be considered potentially carcinogenic for man.

V. QUANTITATIVE RELATIONSHIPS

The major new argument presented today against the "anticancer clause" is that the marked increase in sensitivity of many analytical methods makes it possible to detect low levels of carcinogens in a broader segment of the environment and that, therefore, the immediate enforcement of regulations requiring zero tolerance becomes more difficult, in some instances impossible.

New and very potent classes of chemical carcinogens, such as aflatoxin and nitrosamines, have been detected in the environment. Striking examples of ot... ...on in cancer induction have been reported in experimental animal tests and in epidemiologic observations. Bioassays have revealed the carcinogenicity of such widespread environmental chemicals as DDT and cyclamate, to which a large majority of the American population has been exposed.

In contrast to the analytical methods, bioassay methods have remained tools of low sensitivity, capable only of detecting the highest peaks of carcinogenic activity. The factor which limits bioassay sensitivity is usually the small number of test animals used. If the bioassay design has a low probability of detecting carcinogenic effects produced by hazards at levels comparable to those present in environmental samples, then tests at such levels are wastes of time, effort and money. The need to test dose levels higher than those found in the environment is thus founded. Some substances, on the other hand, are potent carcinogens in animal test systems at levels not currently detectable in the environment. An example is provided by the recent evidence on aflatoxin. Its lowest analytically detectable level is 1 ppb. One hundred percent tumor incidence was produced in rats by a dose as low as 15 ppb. in the diet. Experiments now under way suggest that aflatoxin, when fed to rats at the lowest detectable level (1 ppb), is still carcinogenic (*16*). It has already been demonstrated to be carcinogenic at ppb in the trout. These data indicate that aflatoxin may be present in food at undetectable levels and still be capable of producing cancer incidences so high as to be detectable in tests involving relatively small numbers of experimental animals.

It is impossible to establish any absolutely safe level of exposure to a carcinogen for man. The concept of "toxicologically insignificant" levels (as advanced by the Food Protection Committee of the NAS/NRC in 1969; see Appendix II), of dubious merit in any life science, has absolutely no validity in the field of carcinogenesis. Society must be willing to accept some finite risk as the price of using any carcinogenic material in whatever quantity. The best that science can do is to estimate the upper probable limit of that risk. For this reason, the concept of "safe level for man" as applied to carcinogenic agents, should be replaced by that of a "socially acceptable level of risk".

While science can provide quantitative information regarding maximum risk levels, the task ultimately selecting socially acceptable levels of human risk rests with society and its political leaders. The evaluation of the balance of benefits and risks, required for such a decision by society, should not be the result of uninformed guesswork but should be reached on the basis of complete and pertinent data, social as well as scientific. It is necessary, therefore, to define the extent in the processes of interpreting animal response data (Appendix III) and subsequently extrapolating them to man (Appendix IV). The principle of zero tolerance should be applied in all but the most extraordinary of cases.

VI. CONCLUSION

Modern society has been extremely fortunate—given the technical limits on detection of carcinogenic effects—that at least some environmental carcinogens have been identified. So-called negative data, obtained in bioassays often incapable of detecting effects below the 10 percent level, are grossly inadequate to give assurance of safety for man. Information on about 2,500 compounds tested for carcinogenic activity up through 1960 has been compiled and published (*17*). Most of these materials, however, are of no environmental significance. Data on tests reported since 1960 will be published shortly. It is estimated ... on 2,500 previously unevaluated chemicals will be included in the

forthcoming volume. It is seen, then, that about 6,000 chemicals are d[illegible] as having undergone carcinogenesis bioassay to date. Many of the [illegible] tests, however, were inadequate according to presently recommended st[illegible]

If this nation wishes to identify a large segment of existing and potential carcinogenic hazards, it must institute a comprehensive program involving a concert of actvities. Scientific and technical plans for the development of methodological standards should be provided by experienced agencies in collaboration with qualified advisors. It is essential that the objectivity of these advisors not be damaged by any conflicting interests.

Resources needed for the extensive bioassay screening of environmental chemicals will be considerable. In addition to the myriad of substances presently in the environment, several thousand new compounds are introduced each year. Up to 20,000 materials should be tested for carcinogenicity as a first screening of the environment. Testing 20,000 compounds by bioassay would cost about $1 billion. This estimate would increase accordingly for the more extensive testing required in less superficial evaluation. Yet even were such funds available today, they could not nearly be spent effectively. Bioassay laboratory and professional resources are just not available in quantities capable of supporting a huge testing program. A great deal of "tooling up" is prerequisite to any such expanded level of effort.

Because the latent period in human carcinogenesis is so long, epidemiologic evidence develops only over periods of 15 to 20 years. Timely decisions to exclude materials from uses involving exposure to man, therefore, must be based solely on adequately conducted animal bioassays. Retrospective human evidence of risk must not be allowed to show itself before controlling action is taken. Chemicals should be subjected to scientific scrutiny rather than given individual "rights"; they must be considered potentially guilty unless and until proven innocent. Valid evidence must come from biological assays; every bioassay report should include a statement of its limits of sensitivity. Experimental design should provide for reproducibility of test results. Since the bioassay plays such a key role in a total carcinogen control scheme, more effort must be devoted to setting standards for both the performance of tests and the interpretation of results. Only given good bioassay data can science possibly provide sound information to those who are charged with making social decisions regarding the acceptability of carcinogenesis risk levels.

An effective program to protect man from the mass of environmental cancer hazards is within reach. No more time should be allowed to pass before the recommendations set forth in this report are applied to reality.

Appendix I—Chemical Detection Methods: Analytical Procedures and Their Sensitivity

A review of these methods has recently been published by the International Union Against Cancer (*1*). A brief summary follows.

I. Polynuclear Compounds

Area of concern.—Carcinogenic materials falling into this general class are, at least potentially, produced under all circumstances where pyrolysis of organic substances occurs. Many members of this chemical group are carcinogenic. Analytical methods provide separation and determination of benzo(*a*)pyrene, dibenz(*a,h*)anthracene and dibenz(*a,h*)acridine and other compounds commonly found together in combustion products (tars, soots, petroleum derivatives, etc.).

Analytical methods.—Acceptable analytical methods must be capable of separating and measuring at least the specific materials mentioned above. At present the methods which appear most effective depend on absorption, fluorescence spectrometry, mass spectrometry, or gas-liquid chromatography for quantification and one of several chromatographic techniques for separation.

Sensitivity.—The minimum concentration of polynuclear compounds which may be determined by present methods is approximately 1 part of an individual compound per billion (1959 sensitivity approximately 100 ppb.). 188

II. CHLORINATED HYDROCARBONS

Area of concern.—The chlorinated[1] hydrocarbons have been and still are extensively used as industrial solvents and reactive intermediates. Carbon tetrachloride is a well-known liver toxin and is suspected of being a carcinogen. During the past decade, other chlorinated hydrocarbons have been widely used as persistent pesticides and general exposure of man has occurred. DDT, DDD, aldrin, dieldrin and heptachlor have been reported as carcinogenic in animals.

Analytical methods.—Current methods are based on extraction and condensation followed by separation and quantification by gas chromatography.

Sensitivity.—The advent of electron capture detectors has made methods of analysis for this class of compounds extremely sensitive. Current minimum levels of detection are about 0.1 ppb (1959 sensitivity approximately 10 ppb).

III. AROMATIC AMINES AND CHEMICALLY RELATED COMPOUNDS

Area of concern.—For purposes of this discussion the "aromatic amine" are considered to include not only the substituted aromatic amines but also those compounds (nitro-, azo-, or hydroxylamine compounds) capable of being converted into aromatic amines by metabolic processes. Occupational exposure and exposure through the air, foodstuffs, plastics, and drinking water pose threats of carcinogenic hazards for humans. One must also consider the contribution to the carcinogenic load of endogenous aromatic amines such as certain tryptophan metabolites.

Analytical methods.—General methods for the determination of "total aromatic amines" are of little value because of the wide variation in carcinogenicity between members of the class. Estimation of specific substances is generally effected by their conversion to primary aromatic amines and then to azo dyes by diazotization and coupling; the azo dyes are separated chromatographically and estimated colorimetrically.

Sensitivity.—Methods for detection of members of this general class vary widely in their ensitivity due to the diverse properties of the compounds included. Azo compounds are easily estimated at sensitivities on the order of 10-100 ppb, while aromatic amines and hydroxylamine can be estimated with precision only at levels of about 1 ppm (1959 sensitivity about the same).

IV. N-NITROSO COMPOUNDS

Area of concern.—During recent years many members of this class of chemicals (nitrosamines and nitrosamides) have been recognized as highly potent carcinogens capable of inducing cancer in a variety of organ sites. There is a growing concern that these materials may represent significant cancer hazards to man. These compounds first came to our attention as a result of their utilization as industrial solvents and chemical intermediate, but they may be widely distributed at low levels in a variety of natural products. It is suspected that they may even be formed by the interaction of natural products in the organism or during food preparation.

Analytical methods.—Methods in current use depend on the extraction of these substances from a variety of starting materials and cleanup of the extract by various chromatographic techniques followed by quantification of the individual compounds by gas-liquid chromatography. Specific methods have only been developed for a few individual members of the class. No satisfactory methods for the measurement of nonvolatile nitroso compounds have yet been developed.

Sensitivity.—Minimum detectable levels for the individual compounds are at present about 100 ppb (1959 sensitivity=relatively insensitive colorimetric or polargraphic procedures).

V. AFLATOXINS

Area of concern.—Human exposure to the aflatoxins occurs principally by way of contaminated foods. It is now clear that such contamination can occur in essentially any food commodity, when harvest, storage, or transport conditions permit the growth of specific spoilage molds.

Analytical methods.—Currently used methods involve extraction and cleanup followed by identification of the compounds on thin layer chromatograms viewed under long wave ultraviolet light.

Sensitivity.—Although problems are associated with all of the presently available techniques, detection is possible at the level of 1 ppb (1959 sensitivity = problem was unrecognized).

VI. INORGANIC SUBSTANCES

Area of concern.—A number of inorganic substances of common occurrence in the environment have been reported in the past to be carcinogenic in man or certain animal species. They include compounds containing the following elements: arsenic, beryllium, cadmium, chromium, cobalt, lead, nickel, silver, titanium.

Analytical methods.—Analysis of the metals is performed today by atomic absorption spectroscopy after apropriate extraction and concentration procedures.

Sensitivity.—The lower limits of detection for the metals listed are on the order of 1 ppb (1959 sensitivity = about 10 ppb).

VII. ASBESTOS

Area of concern.—This substance is a fibrous particulate material produced in vast amounts for many industrial uses and recently found to be a widespread air pollutant. Major monitoring needs concern its presence in the general atmosphere and as an industrial dust.

Analytical methods.—Although sensitive methods are available for the detection of the elemental components of this substance, no specific chemical methods for identification of asbestos itself are available. Its estimation is still based on microscopic identification and count of asbestos particles in measured samples.

Sensitivity.—Extremely low and little improved since 1959.

VIII. OTHERS

A number of other carcinogens, belonging to a wide variety of chemical classes, need to be analyzed with specific methods. Their enumeration exceeds the limits of the present discussion. It is also necessary to improve the detection of materials which are recognized as potential sources of carcinogens and for which no adequate analytical methods are presently available (e.g. secondary amines and nitrites, which may interact to form nitrosamines).

APPENDIX II—COMMENTS ON 1969 REPORT OF THE FOOD PROTECTION COMMITTEE

This Committee has examined a report entitled "Guidelines for Estimating Toxicologically Insignificant Levels of Chemicals in Food" published in 1969 by the Food Protection Committee—Food and Nutrition Board of the National Academy of Sciences—National Research Council. It records its strong objections to the principles expressed in that report, which states that natural or synthetic substances can be considered safe without experimental support under certain vaguely-stated conditions.

The Food Protection Committee Report assumes that ". . . a level of insignificance may be determined if: (1) There are available adequate scientific studies that establish safe levels of similar magnitude for at least two analogous substances. (2) The acute or subacute toxicity of the new substance and two analogous substances is of the same nature and degree." For "Chemicals in Commercial Production" it recommends that: "If a chemical has been in commercial production for a substantial period, e.g. 5 years or more, without evidence of toxicological hazard incident to its production or use, if it is not a heavy metal or a compound of a heavy metal, and if it is not intended for use because of its biological activity, it is consistent with sound toxicological judgment to conclude that a level of 0.1 ppm of the chemical in the diet of man is toxicologically insignificant."

To assume (a) that a 5-year period of use has any meaning for the evaluation of chronic toxicity in man, (b) that any chemical may be considered safe simply because two "analogous substances" are "safe", and (c) that acute or subacute toxicity are reliable guidelines for evaluating long-term toxicity is to display a lack of understanding and appreciation of factors involved in chronic toxicity, particularly of the irreversible and delayed toxic effects which occur in carcinogenesis.

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nce the purpose of the report is to recommend guidelines and priorities for
ting chemicals for human use without direct experimental toxicological
nation, the lack of consideration of irreversible long-term toxic effects (which
ld not be ruled out by the suggested criteria) makes the suggested approach
tically inapplicable and potentially dangerous.

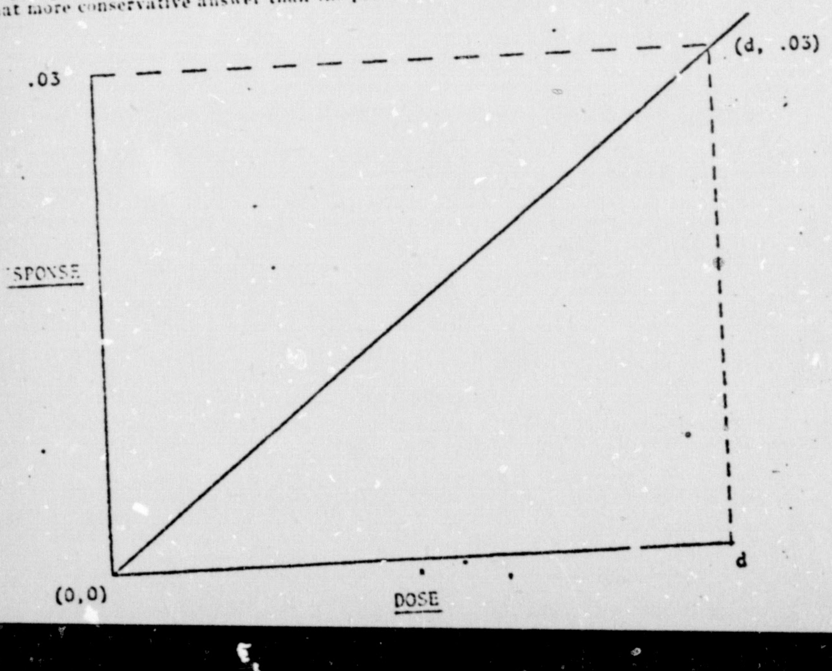
APPENDIX III—A METHOD FOR DETERMINING THE DOSE COMPATIBLE WITH SOME "ACCEPTABLE" LEVEL OF RISK

(Contributed by Dr. M. A. Schneiderman)

INTRODUCTION

n establishing the concept of an "acceptable" risk dose (ARD) we must
r in mind that the dose level arrived at gives a tolerable risk *only for the
ries for which the extrapolation has been made*. Given this caveat, to make
onservative* estimate of an ARD, two assumptions need to be made:
A. The dose-responsive curve at low response levels is concave upward (e.g.
left-hand tail of the common S-shaped curve). The upper (dose) limit of
is S-shaped curve is a straight line going through the 0,0 point (no dose=
response). The true dose-response curve is shallowest at this point.
B. A given set of data will provide an estimate for the upper limit of the other
oint through which the straight line must pass (which then gives the upper
nit of the slope of the dose-response curve).
As an example of the use of the ARD concept, let us suppose that we have
served 100 control animals and 100 treated animals at a given dose rate, d,
nd have seen no tumors in either group. The upper 95% confidence limit on
ch a result is 3/100 (i.e. the data are consistent with the statement that with
true response rate of .03, we might expect to see zero tumor incidence in 95%
f similar experiments). If the socially "acceptable" risk selected is to be one
dditional cancer case for each hundred thousand persons, it is now desired to
stablish an ARD which will produce a maximum lifetime tumor incidence of
100,000. We can then construct the graph:

* The procedure outlined here is essentially the "one-hit" procedure and gives a some-
hat more conservative answer than the procedure of Mantel and Bryan (4).



The line connecting the (0,0) point with the (d, .03) point has

$$\text{Slope} = .03/d$$

and the equation of the line is:

$$\text{Response} = (\text{Dose})\,(.03/d)$$

If we wish to determine some dose (e.g. the ARD) which would be predicted to yield a response of not more than $1 \cdot 10^{-5}$ we would write:

$$\text{Dose} = (1 \cdot 10^{-5})\,(d/.03) = 3.3 \cdot 10^{-4} d)$$

ARD

Working towards an ARD this way has several consequences:

a. An increase in the experimental size (at the same dose, d, and with the same experimental result, i.e. no tumors) will reduce the upper confidence limit. Thus, if there were 200 animals in each contrast group, the upper 95% confidence limit would be about halved and the estimated ARD would be doubled.

b. An increase in the dose, d, at which the result (no tumors) occurred would increase the estimated ARD in direct proportion to the tested dose. Thus, if the initial experiment had been conducted at twice as high a dose *with the same result*, the estimated ARD would be twice as high as that determined from this experiment.

The procedure outlined has the virtue of lending greater credence to conclusions reached on the basis of larger experiments. Higher estimated ARD's will be found under such circumstances and the confusion between "not statistically significantly different", and "not different" can be avoided.

It must be stressed that these calculations do not establish an "acceptable risk dose" for man. The procedures do not tell us for example what factors are required to extrapolate from animal to man, although the following factors must certainly be considered.

1. Dose-response curves in man (a grossly non-homogeneous animal) are likely to be much shallower than dose-response curves in experimental animals. This implies higher levels of response at low doses for man, other things being equal.

2. It is possible that even the use of the straight line between the 0,0 point and some experimentally determined dose-response point (plus upper confidence limit) may yield too high an estimated ARD for man.

3. Whether the proper blow-up factor for doses in man should be on a mg/kg or mg/M² basis, or any other basis, must be established independently.

4. Nothing in this procedure would enable one to know where the dose-response curve for man belongs along the dose scale in comparison with the dose-response curve for the experimental animal. If man's curve lies much to the left of the experimental animal's curve, then an ARD for the experimental animal may be a gross overdose for man.

Where several species are studied, it would seem safest in the absence of better information, to accept for man an ARD no greater than the lowest ARD dose derived from the results for the several species. It has been suggested that an appropriate "safety factor" for man should involve a reduction in the ARD for animals by a factor of 100 to allow for species' differences, another factor of 100 to allow for interactions with other carcinogens, and another factor of 100 to hedge against the incorrect choice of "blow up" (weight, or surface area) from animals to man. This would imply an ARD in man of about 1×10^{-6} the ARD in animals.

INSTRUCTIONS FOR CALCULATION OF THE ARD USING 95% AND CONFIDENCE LIMITS

(Experiment in which no animals in either treated or control group show a response, e.g. development of a tumor): We need the following values:

C=Upper confidence limit on the result (computed as shown below).

S=Arbitrary "acceptable" response level.

d=Acceptable risk dose (ARD), that which causes no more than the arbitrarily allowed acceptable risk.

t d=Test dose, some multiple, t, of the tolerated dose.

These values are related as shown:

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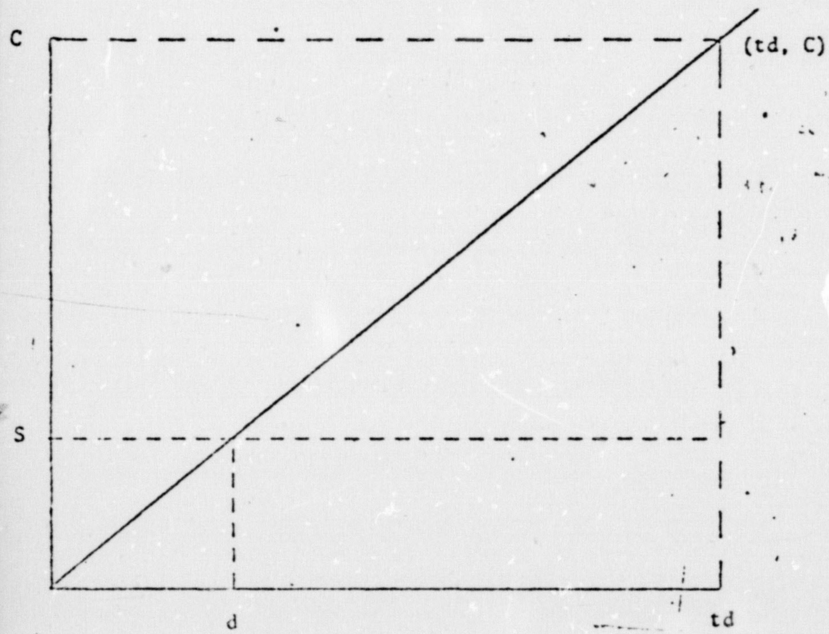


'rom the above figure, we have the following relationships: $C/S=(t \cdot d)/d=t$ hich can also be stated as $C=St$.

Since C is a function of the size of the experiment, N, we have a relationship etween S, t, and N where N = sample size.

For zero positive responses, the upper a% confidence limit is $St=C=1-e[\ln(1-a)]/N$, where ln is the natural logarithm. From this rela-ionship, given any two of the values N, t, and S, we can solve for the third. The ccompanying graphs have this relationship shown for difference values of N. 'igure A1 s for a 95% confidence limit: Figure A2 is for a 99% confidence imit.

In any specific situation St is constant (=C), so that we can increase the ange of the chart by dividing S (the tolerable risk level) by k while multiplying (the dose multiplier) by k. Two sets of values for S and t are shown on each raph.

EXAMPLES OF HOW TO USE GRAPHS

Given:

a. That we agree to a socially "acceptable" risk level, say .00001 (1 in 100,000).

b. The expected average dose in man is D, and we wish to determine whether is compatible with the acceptable risk.

c. The maximum pharmacologically tolerated dose in our test species is tD, here, say, t=600, (i.e. this species can survive a dose 600 times larger than the verage dose in man).

'rocedure (Using "95%" figure)

a. Find t=600 along the bottom scale of the graph. Notice that it is in paren-hesis. This means we must look for our S value in parenthesis, too. (Small rrow at bottom of graph.)

b. Find $S=10(\times 10^{5})$. (Small arrow at side of graph.)

c. Find where the t=600 vertical line crosses the S=.00001 horizontal line. This s at the diagonal line labeled 500.

This means we must conduct an experiment with 500 animals in each group, ielding 0 positives, at a dose level 600 times the "average" dose in man, in order o have some assurance that the average dose in man is within the acceptable risk evel, where acceptable risk is .00001. [This dose may be far too high, for it has een assumed that man's dose-response curve is the same (except for slope) as

the animal species in which we did the experiment. No "safety" factors have been applied.]

2. *Given*

To repeat the above experiment using a dose 300 X the expected ARD. S=.00001, and t=300.

Procedure

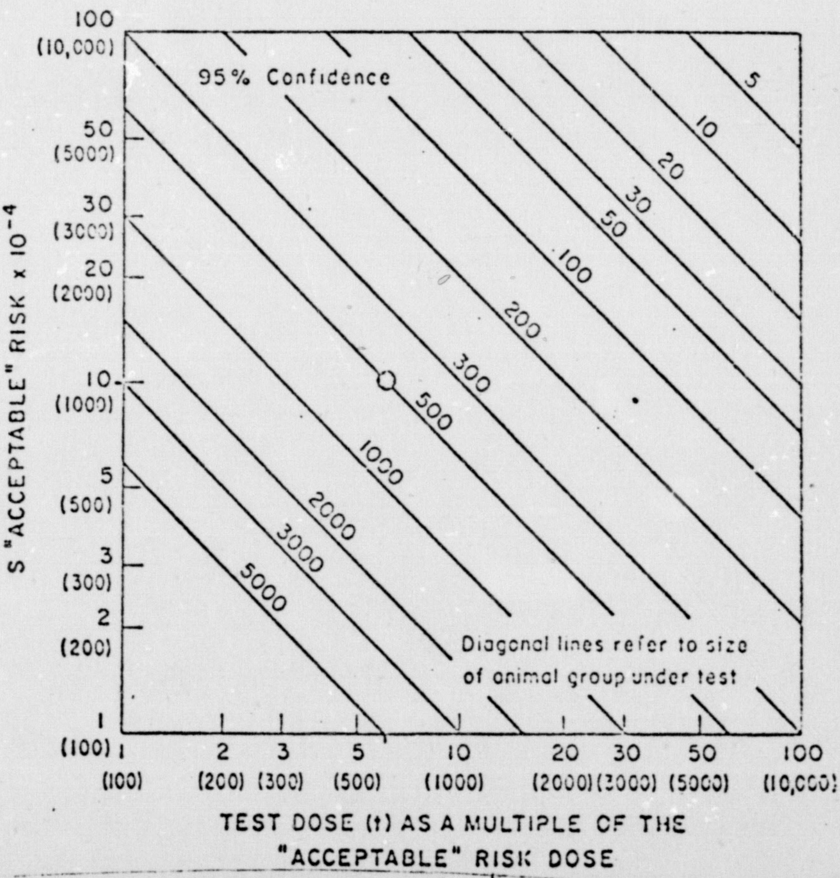
Find t=300 along the bottom scale (in parenthesis).
Find S=10(X 10^{-4})
Note the crossing point at diagonal N=1000.
This means if we test at a lower dose, we must have more test animals to achieve the same ARD.

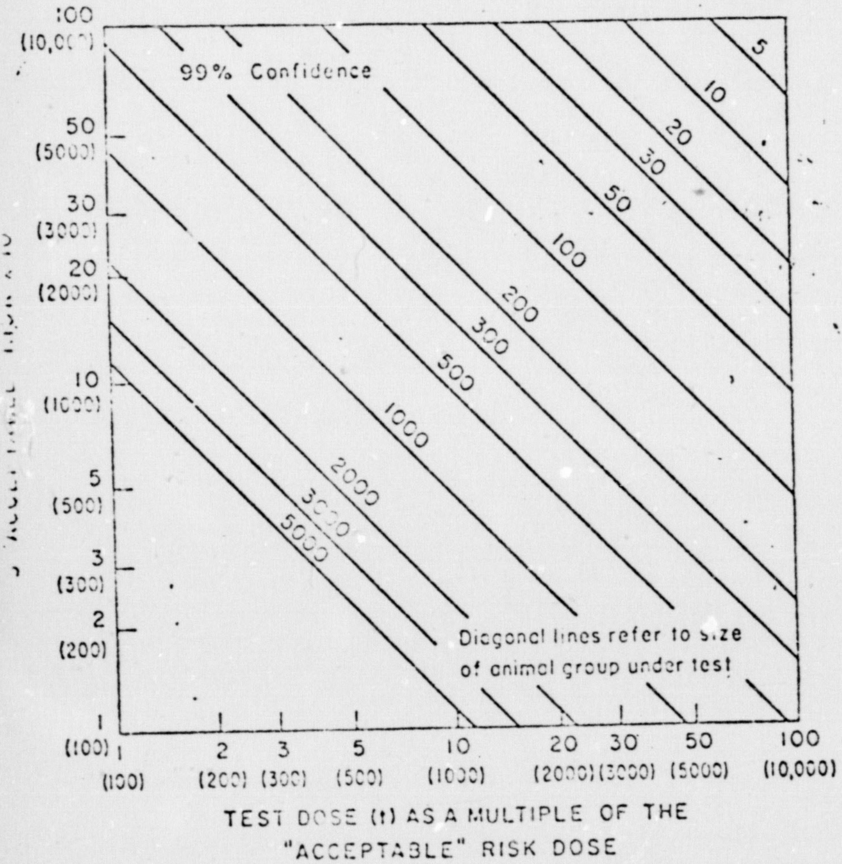
3. *Given*

To repeat experiment *1* using only 100 animals. N=100; S=10(×10^{-4})

Procedure

Follow along the horizontal line until you come to diagonal N=100
Look down to the t scale and note that we are at t=3000.
This means if we test with fewer animals, we can have assurance only that a dose 1/t times the test dose will yield less than the acceptable level. Fewer animals in a test imply a lower ARD. In this case the ARD is 1/3000 the test does as compared with 1/600 in Example 1.





APPENDIX IV—RELATIONSHIP BETWEEN CHEMICAL ANALYSIS, BIOLOGICAL ASSAYS AND CARCINOGENIC RISKS TO MAN

The following set of Figures presents a conceptual scheme for dealing with he problems stated. In practice any or all of the steps may be rendered imossible by limitations in quantifying pertinent variables. Operational problems n implementing the plan result from uncertainties in the correspondence of uman and animal dose response curves, extrapolation of animal data to exremely low response levels, differences in response from species to species, ynergistic effects, etc. The scheme itself may be useful, however, in defining the pecific areas in which further efforts should be made.

'ROBLEM No. 1: GIVEN THE PRESENCE OF A CHEMICAL IN THE ENVIRONMENT, ESTIMATE ITS CARCINOGENIC HAZARD FOR MAN AND DETERMINE ITS COMPATIBILITY WITH A SOCIALLY "ACCEPTABLE" RISK

The inputs and the estimations required for this problem are represented in Figure 1 and discussed in the following paragraphs.

1. Analytical Detectability in the Environment—Limited by the sensitivity and specificity of the available analytical method.

2. Quantitative Distribution in Time and Space in the Environment—Preparaion of "environmental profiles" limited chiefly by extent of sampling. Segments of the environment should not be considered non-contributory, because they fall below the minimum levels for analytical detection.

3. Level and Extent of Exposure in Man—Limited primarily by amount of information regarding routes and extent of human exposure, and by extent of sampling.

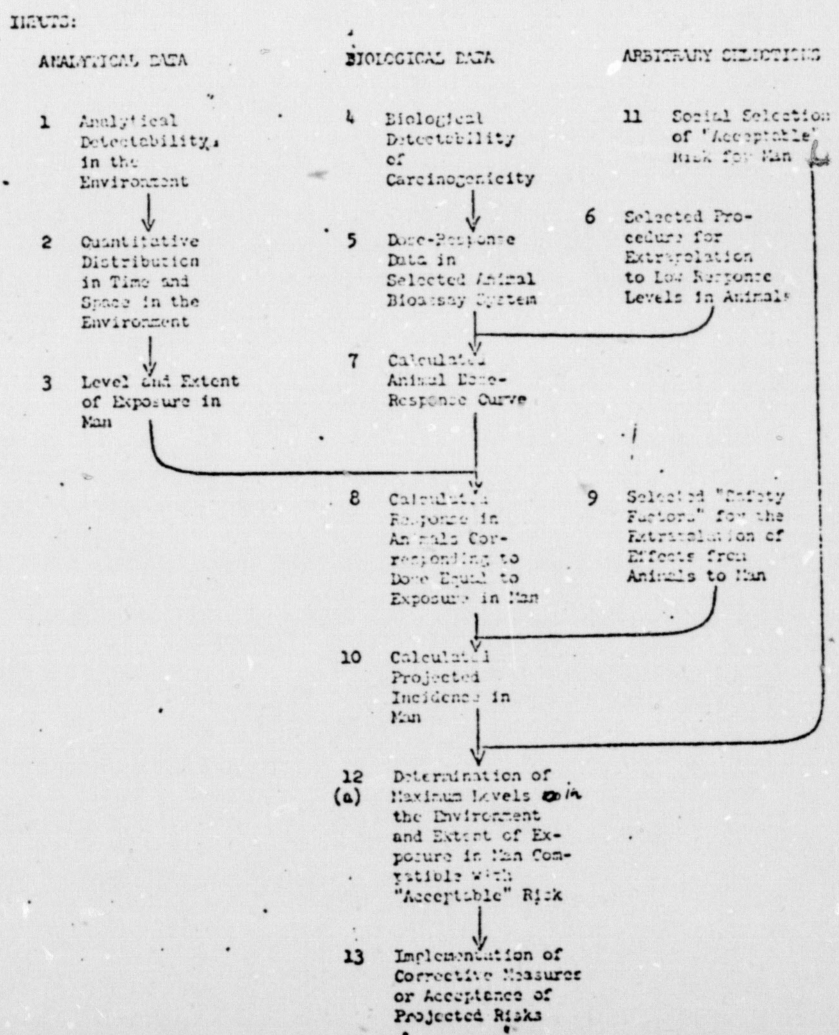
4. Biological Detectability of Carcinogenicity—Limited by the sensitivity and specificity of available animal bioassay design.

5. Dose-Response Data in the Selected Animal Bioassay System—Limited by the sensitivity of the experimental design.

6. Selected Procedure for Extrapolation to Low Response Levels in Animals—An arbitrary selection from among a variety of available models made so as to avoid underestimating the risk. A proposed methodology for this extrapolation is presented in Appendix III.

7. Calculated Animal Dose-Response Curve—Obtained by calculation from Items 4, 5, and 6.

PROBLEM NO. 1 - GIVEN THE PRESENCE OF A CHEMICAL IN THE ENVIRONMENT, ESTIMATE ITS CARCINOGENIC HAZARD FOR MAN AND DETERMINE ITS COMPATIBILITY WITH A SOCIALLY "ACCEPTABLE" RISK.



Box Numbers refer to Text

Figure I

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8. Calculated Response in Animals Corresponding to a Dose Equal to Exposure in Man—Obtained by calculation from Items 3 and 7. This provides the basis for the extrapolation from the response in animals to that in man in steps 9 and 10.

9. Selected "Safety Factors" for the Extrapolation of Effects from Animals to Man—This selection is of necessity an arbitrary one, but it must be based on informed judgment. It is severely limited by our lack of specific information on effects in man, and should be made so as to avoid underestimating the risk. The choice of a safety factor of 100, frequently applied in cases of reversible toxicity, is inadequate to cover the complex assessment of carcinogenic risks in man. A factor should be applied for at least each of the following parameters: species susceptibility, interaction and potentiation effects, correction for animal size or body weight.

10. Calculated Projected Incidence in Man—Obtained by calculation from Items 3, 8, and 9, i.e., by taking the level of exposure in man, calculating the tumor incidence that this level of exposure would produce in the animal, and multiplying it by the total selected "safety factor".

11. Social Selection of "Acceptable" Risk for Man—This arbitrary selection is a determining element in the process of decision. It must be based on the most extensive information available on the consequences of accepting a given risk and on the projected "benefits" that would result.

12. (a) Determination of the Maximum Levels in the Environment and Extent of Exposure in Man Compatible with Socially "Acceptable" Risks—Compare Items 10 and 11; if projected incidence in man is greater than acceptable risk, determine what level of exposure in man (Item 3) would give an incidence in man (Item 10) equal to or lower than the acceptable risk (Item 11). Exposure can be reduced by changes in the environmental levels and distribution, or by reducing the number of people exposed.

13. Implementation of Corrective Measures, or Acceptance of Projected Risks—Implementation of corrective measures necessary to reduce the projected risk to a socially acceptable level may be extremely difficult. In such cases, the extent of the risk should be clearly stated and a continuing effort developed towards control of the problem.

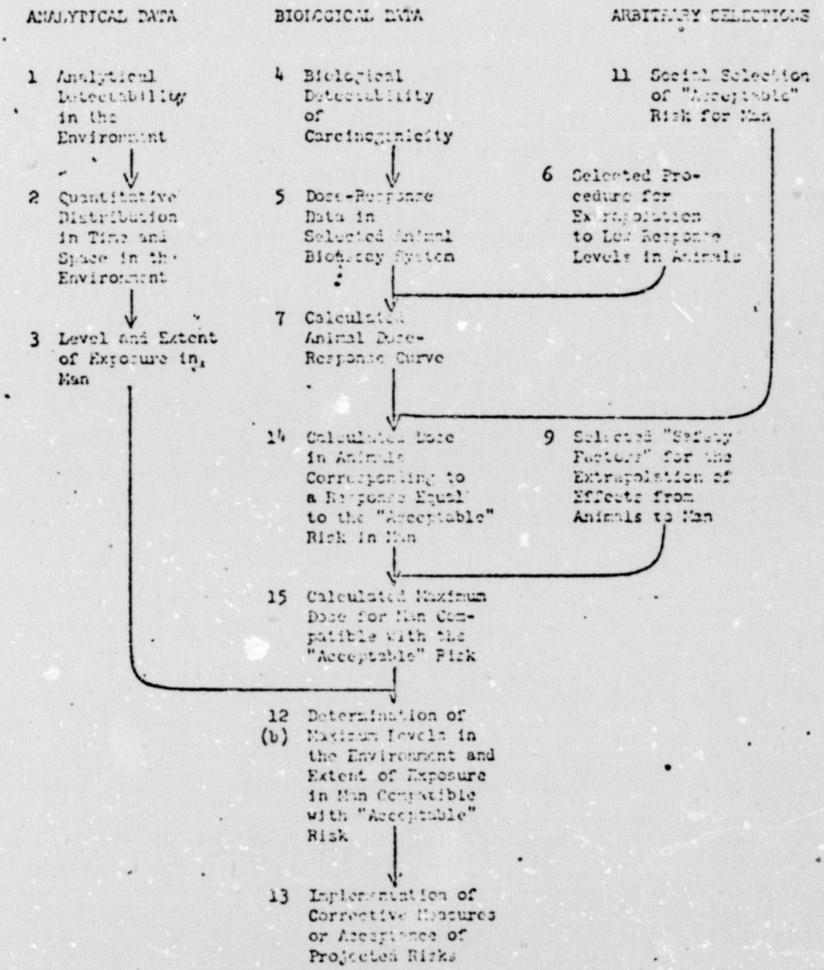
PROBLEM NO. 2: GIVEN A PROPOSAL TO INTRODUCE A CHEMICAL INTO THE ENVIRONMENT, ESTIMATE THE MAXIMUM EXPOSURE LEVEL FOR MAN COMPATIBLE WITH A SOCIALLY "ACCEPTABLE" RISK

The inputs and estimates required for this problem are represented in Figure . The same definitions used for Problem 1 apply. Two different calculations are involved, those in steps 14, 16, and 12(b).

14. Calculated Dose in Animals Corresponding to a Response Equal to the "Acceptable" Risk for Man—Obtained by calculation from items 7 and 11.

PROBLEM NO. 2 - GIVEN A PROPOSAL TO INTRODUCE A CHEMICAL INTO THE ENVIRONMENT, DETERMINE THE MAXIMUM EXPOSURE LEVEL FOR MAN COMPATIBLE WITH A SOCIALLY "ACCEPTABLE" RISK

INPUTS:



Box Numbers refer to Text

Figure II

15. Calculated Maximum Dose for Man Compatible with the "Acceptable" Risk—Obtained by calculation from Items 9, 14 and 11.

12. (b) Determine the Maximum Levels in the Environment and Extent of Exposure in Man Compatible with Socially "Acceptable" Risks—Based on the calculated maximum dose for man compatible with the "acceptable" risk (Item 15), determined: a. what level and extent of exposure in man would result in a risk equal to or lower than the acceptable risk (Item 11): b. what quantative distribution of time and space in the environment (Item 2) would result in the selected level of exposure in man (Item 3).

The logic sequences, illustrated for the two basic problems of estimation of carcinogenic risks, require these categories of information:

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1. Factual information on the sensitivity of analytical methods and on the xtent of environmental distribution and of exposure in man (Items 1, 2, and 3).
2. Factual information on the limits of the biological determination of carinogenicity, represented by the sensitivity of bioassay methods, the significance evels of the results obtained, and the dose-response data (Item 4, 5).
3. Documentation of the criteria and procedures used for the selection of the rbitrary factors used in the evaluation process. These factors include the election of a socially "acceptable" risk, of a procedure for dose-response extrapolations in the animal model and of "safety factors" for the extrapolation from nimal to man (Items 6, 9, 11).

Only in the case of substances for which we have extensive analytical environmental data and extensive bioassay results (probably including a doseesponse study of acceptable quality) can we attempt the exercise of estimating ome dose corresponding to an "acceptable" risk for man. This can only be one by clearly stating the justification for each of the arbitrary extrapolation actors chosen. The selections will be justified only if they represent an upper mit of risk acceptance, that is, if they assure us that the risk in man is not nderestimated.

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US Govt Print Office, 1951, 583 p; Shubik P, Hartwell, JL: Supplement 1 to the above. Washington DC, US Govt Print Office, 1957, 388 p; Peters J: Supplement 2 to the above. Washington DC, US Govt Print Office, 1969, 655 p.

Dr. SAFFIOTTI. The second report I mentioned is concerned more specifically with the "Carcinogenicity of Pesticides." It is the report of the Technical Panel on Carcinogenesis of the HEW Secretary's Commission on Pesticides and Their Relationship to Environmental Health (ch. 5, pp. 459-506 of the Commission's report), which has been quoted previously in these hearings. It is the report prepared by the experts that the Commission appointed as qualified to evaluate the problem of carcinogenicity. The NCI scientific staff actively participated in the discussions and the extensive review work of that Panel, and I will quote several statements from that Panel's report, which I think summarizes what is involved in this issue.

The Techincal Panel on Carcinogenesis has reached the following positions:

1. The presence of carcinogenic substances (of both synthetic and natural origin) in food might be a significant factor in the occurrence of what is commonly referred to as "spontaneous" cancer in man and animals. Thus, an important object in cancer prevention is the elimination, or reduction to a minimum achievable level, of all substances in the diet of man proven to be carcinogenic in either man or animal.

2. Since the effects of carcinogens on target tissues leading to tumor formation appear irreversible, with accumulation of effects over extended periods of exposure, the reduction of exposure to carcinogenic substances to the lowest practicable level may be one of the most effective measures towards cancer prevention.

3. Many different factors may influence dose-response in carcinogenesis in man and animals. Their complexity is such that no assuredly safe level for carcinogens in human food can be determined from experimental findings at the present time.

INTERPRETATION OF THE RESULTS AND VALIDITY OF ANIMAL TESTS

"Interpretation of results of bioassays on a test material includes consideration of the accuracy and significance of the experimental studies, i.e., experimental design, details of information on test materials, dosage, route of administration, metabolism, excretion and retention, controls (positive and negative), experimental animals and methods, survival, description and time of appearance of toxic and pathologic effects, number, type, and individual distribution of tumors.

Extrapolation from animal data to man.—The evaluation of carcinogenic hazards for man is based on a judgment of all available information: on bioassay, on toxicologic, metabolic, and pharmacologic studies, on the extent and route of exposure of man, and on epidemiologic studies. Each compound must be evaluated individually on the basis of all data on its use and effects, including whether residues may occur as a result of use of the particular compound, the nature of its betabolites in man, the storage or retention and excretion, etc. The position of this Panel is that the different qualitative and quantitative responses of various animal species, including man, to carcinogens make meaningful extrapolation from "no-effect" levels in dose-response studies in animals to man currently impossible.

In brief summarys: (1) Food additives and contaminants should only be permitted if evidence is provided of no carcinogenic effect after adequate long-term bioassays. The minimum requirements for such bioassays should include: Adequate numbers of animals of at least two species and both sexes with adequate positive and negative controls, subjected for their lifetime to the feeding of a suitable dose range of the test material, including doses considerably higher than would be present in food; (2) any substance which is shown conclusively to cause cancers in animals, when tested under these conditions, should be considered potentially carcinogenic for man and therefore not innocuous for human consumption. Tests which yield benign tumors will nevertheless raise the level of suspicion.

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APPENDIX B

EXPOSURE DATA FOR POLYVINYL CHLORIDE (PVC) AND VINYL CHLORIDE MONOMER (VCM) PLANTS

APPENDIX B

EXPOSURE DATA FOR POLYVINYL CHLORIDE (PVC) AND VINYL CHLORIDE MONOMER (VCM) PLANTS

This appendix presents exhibits summarizing the exposure data from a number of PVC and VCM plants. The appendix also contains a confidential inventory of PVC workers for 1974 (see Exhibit B-1), used for reference purposes in Chapter III discussions of employment.

An explanation of the elements of the coding that is assigned to the data sources follows:

- Random leading numbers only appear for VCM plants
- Random leading numbers appear for PVC plants followed by possible symbols ~~as~~ shown
  - PVC plant capacity

    S = small, less than 100 million lbs
    M = medium, 100 to 200 million lbs
    L = large, over 200 million lbs

  - PVC plant age

    New = 0 to 10 years
    Int. = 11 to 12 years
    Old = over 20 years

  - PVC plant siting

    C = cold climate
    W = warm climate

The exhibits presented in this appendix are arranged in the following manner for clarity of presentation.

- Exhibits presenting PVC industry submitted VCM monitoring data are numbered B-2 through B-21.

- Exhibits B-22 through B-24 present the Snell assessment of the industry data and data submitted to Snell by OSHA.

- Exhibits numbered B-100 through 106 contain VCM industry submitted VCM monitoring data.

- Exhibits B-107 and B-108 show the Snell assessment of the industry data and data submitted to Snell by OSHA.

The data contained herein will provide general location of VCM source in a plant, VC concentration in ppm, number of employees exposed at given work posts, and in most cases the measurement methods.

There is some evidence that data obtained from manual sampling versus area monitoring may be biased downward. A PVC producer presented data showing the comparative results of sampling in the same area by manual methods and by means of five twenty points automatic sequential sampling chromatographs. The results are presented below.

	Number of Samples	Average	Point Range (95%)
Manual Sampling	218	10.14	0 - 46
Automatic Sampling	one full day	16.30	0 - 64

Without a statistical analysis of the population it is premature to affirm that a bias exists between manual and automatic sampling, particularly since one deals with a one-sided distribution. However, in view of the magnitude of the difference of the averages a real bias is likely.

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EXHIBIT B-1
USDOL/OSHA
CONFIDENTIAL INVENTORY OF POLYVINYL
CHLORIDE WORKERS - 1974

Plant Start-Up Date	No. of Workers	Plant Start-Up Date	No. of Workers
1957	64	1947	140
1963	46	1959	74
1961	80	1955	150
1963	155	1950	74
1946	75	1971	30
1966	158	1953	241
1968	120	1965	200
1954	130	1947	350
1953	300	1965	70
1960	40	1965	180
1970	55	1942	266
1946	300	1969	90
1956	60	1955	98
1956	27	1968	150
1956	76	1965	95
1966	140	1967	160
1963	187	1957	70
1936	272	1949	322
			5,045

(1) Since the data is coded and confidential according to the source, it is not clear to Snell what the precise definition of "PVC Worker" is.

Source: Statement of PVC Producers in the United States Relative to Health Experience of Workers in Plants Polymerizing Vinyl Chloride, Draft No. 3, 5/28/74, per private communication with Snell by Arthur B. Steele, Operations Manager, Union Carbide Corporation Chemicals and Plastics, July 26, 1974.

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EXHIBIT B-2 (1)
USDOL/OSHA
MONITORING RESULTS FOR
12 - M - INT. - C

Job Classification	Average Exposure (ppm VCM)	Number of Data Points
Suspension		
Area Foreman	8.4	39
Homopolymer Reactor Operator	10.0	79
Copolymer Reactor Operator	26.1	76
Dryer Operator	5.6	24
Bagger/Cleaner	5.0	59
Labor Pool/Cleaner	5.3	65
Plastisol		
Area Foreman	16.2	32
Shift Foreman	3.7	27
Tower Operator	19.0	176
Laborer	7.6	100
Bagger	2.5	71
Atomizer Dryer Operator	2.0	26
Additive Dryer Operator	2.2	23
Laboratory		
Q.C. Lab. Supv.	2.5	6
Analytical Chemist	0.7	6
Colorist	16.2	6
Q.C. Technician/Days	0.8	5
Q.C. Technician/Shift	3.9	46
Maintenance		
Maintenance Foreman	3.0	28
Mechanic/Shift	3.7	130

EXHIBIT B-2 (2)
USDOL/OSHA

Job Classification	Average Exposure (ppm VCM)	Number of Data Points
Warehouse and Miscellaneous		
Warehouse Supv.	0.5	7
Warehouse Shipping Clerk	1.8	6
Warehouse Receiving Clerk	1.7	5
Warehouseman	0.7	23
Effluent Plant Operator	1.9	22
Boiler Operator	0.9	26
Utility Man	11.0	36
Yard Man and Service Man	0.3	9

Source: Snell summary of industry data

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EXHIBIT B - 3(1)

USDOL/OSHA

17 - S - INT. - W

Job Description	Duties	Number of Employees	Average(1) 8 Hr. TWA PPM	Type of Exposure
Supervisor	General Supervisory	8	5	Intermittent
Senior Operator	General Roving Duties	4	8	Intermittent
Reactor Operator	Reactor Charging, Dumping	4	22	Continuous
Solutions Operator	Reactor Charging, Dumping	4	19	Continuous
Utility	Reactor Cleaning	4	16	Intermittent Wear Masks
Recovery Operator	Stripping, Transfer Slurry	4	17	Continuous
Finishing Operator	Drying	4	7	Intermittent
Bulk Operator	Bulk Loading Resin Transfer	5	7	Intermittent
Bagger	Bagging	6	14	Intermittent
Artisan Operator	Monomer Unloading Utilities	4	6	Intermittent
Mechanic	Maintenance	5	3	Intermittent
Bulk Loader	Material Handler	3	7	Intermittent
Lab Technician	Analytical	4	1	Intermittent

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EXHIBIT B - 3(2)
USDOL/OSHA

Job Description	Duties	Number of Employees	Average(1) 8 Hr. TWA PPM	Type of Exposure
Supervisor	General Supervisory	8	5	Intermittent
3rd Floor Operator	Reactor Charging	8	22	Continuous
Utility	Reactor Cleaning	6	16	Intermittent Wear Masks
2nd Floor Operator	Stripping Transfer of Slurry	4	17	Continuous
Dryer	Drying	4	7	Intermittent
Dryer	Bulk Loading Resin Transfer	4	7	Intermittent
Bagger	Bagging	6	14	Intermittent
Area 5 Operator	Monomer Unloading Utilities	4	6	Intermittent
Maintenance Mechanic	Maintenance	6	3	Intermittent
Material Handler	Warehouse Work	3	7	Intermittent
Lab Technican	Analytical	8	1	Intermittent

Note: (1) Data collected May 1 - July 15, 1974

Source: Snell summary of industry data

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EXHIBIT B -4 (1)
USDOL/OSHA
MONITORING RESULTS FOR
19-L-NEW-W

Unit Operation	(1) Current VC, ppm	How Measured	Historical VC, ppm	How Measured
VCM Unloading	Typical = 40 ppm Ceiling =500 ppm	Gas Chromatograph Organic Vapor Analyser	N/A (2)	N/A
Reactor Operation	Typical = 25 ppm Ceiling =300 ppm	"	N/A	N/A
Drying & Product Transfer	Typical = 20 ppm Ceiling = 75 ppm	"	N/A	N/A
Mechanical Repairs (Flange Breaking, etc.)	Typical = 30 ppm Ceiling =1000 ppm	"	N/A	N/A

(1) Five minute average

(2) None Available

EXHIBIT B-4(2)
USDOL/OSHA

I. VCM UNLOADING AREA

Activity Area	VCM LEVEL ppm
Under Compressor Shed	10 - >200
Guaging VCM Storage Tanks	80
VCM Transfer Pumps	10 - >100
VCM Unloading Platforms	10 - >200

II. V-11 VINYL BUILDING

Activity Area	VCM LEVEL ppm
Recovery System	5 - >100
Building Exposure	5 - >100
At the Dump Strainers	5 - >100
Water Blasting Reactor	40-180
Fresh Air System	0-10

III. V-12 VINYL BUILDING

Activity Area	VCM LEVEL ppm
Recovery System	5 - >100
Building Exposure	5 - >100
At the Dump Strainers	5-65
Water Blasting Reactor	40-180
Charging Control Panel	5-65

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EXHIBIT B -4(3)
USDOL/OSHA

IV. V-11 DRYER BUILDING

Activity Area	VCM LEVEL ppm
Centrifuge discharge	0 - >100
Sifter deck	10-100
Bird deck	10-100
Slurry Hook-up Station	10 - >100
Resin Hook-up Station	6 - >100
Cleaning Dryer	25-35
In Dust Collector	8-80
Taking Silo Readings	10-90
Sifter Overflow	10-35
Resin Bagging	10-100
Resin Warehouse	10-20

V. LARGE REACTORS

Activity Area	VCM LEVEL ppm
Recovery	5 - >100
Sweco	5 - >100
VCM Charge Pumps	0-30

Source: Snell summary of industry data

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EXHIBIT B - 5 (1)

USDOL/OSHA

MONITORING RESULTS FOR
40 - L - NEW - W

Unit Operation	Current VC, ppm	How Measured	Historical VC, ppm	How Measured
V-12 Charge Operation	21	Gas Bag	N/A	N/A
V-12 Recovery Operation	7	Gas Chromatograph		
V-12 Maintenance Mechanic	12			
V-12 Utility	11			
V-11 Charge Operation	42			
V-11 Recovery Operation	50			
V-11 Utility	102			
Large Reactor Lead Operator	1			
Large Reactor Operation	5			
Resin Bagger	13			
Vinyl Area Maing. Shop	3			

EXHIBIT B - 5(2)
USDOL/OSHA

Fork Lift Operator	17
Receptionist Office	1
Engineering Offices	1
Maintenance Shop	1

Note: 1) Continuous monitoring data shown in attached table. This data is as yet experimental.

2) ABD & OKC are presented separately because of difference of equipment and technique.

Source: Snell summary of industry data

EXHIBIT B - 6(1)

USDOL/OSHA

MONITORING RESULTS FOR
4 - M - NEW - W

Table I -- Vinyl Chloride Levels
(non-respirator areas -- grab samples) May 1 -- June 26, 1974

Location	Operation	Vinyl Chloride -- ppm		
		Median	Low	High
Day Tank Area	Pumping VC	3.4	0.0	71.6
Compressor 1K-1	De-gas	7.0	0.0	136.
Compressor 2K-1	De-gas	3.0	0.6	31.4
VP Seal Discharge	De-gas	8.4	0.3	159.
Blower Discharge	During Cleaning	7.0	0.9	34.0
Popo Sampling	Before Discharge	4.5	0.0	46.5
109/209 Blind	Changing Blind	9.3	0.4	137.
Warehouse (2)	Aisle	5.2	0.0	7.7
Laboratory (3)	Workbench	4.0	Not Applicable	
" (3)	Office	1.7	"	"
" (3)	Compositing Samples	6.4	"	"
Office (3)	Center of Area	2.1	"	"

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EXHIBIT B - 6(2)
USDOL/OSHA

Table II -- Distribution of Data -- VC Levels
110 Grab Samples(1)

May 1 to June 26, 1974

Minimum Value	0.0	ppm
Maximum Value	159	ppm

10%	of	samples	showed	VC	levels	of	0.5	ppm	or	less
20%	"	"	"	"	"	"	1.1	"	"	"
30%	"	"	"	"	"	"	1.7	"	"	"
40%	"	"	"	"	"	"	2.9	"	"	"
50%	"	"	"	"	"	"	4.0	"	"	"
60%	"	"	"	"	"	"	6.4	"	"	"
70%	"	"	"	"	"	"	9.7	"	"	"
80%	"	"	"	"	"	"	14.9	"	"	"
90%	"	"	"	"	"	"	26.2	"	"	"
95%	"	"	"	"	"	"	39.7	"	"	"
97.5%	"	"	"	"	"	"	71.6	"	"	"

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EXHIBIT B - 6 (3)
USDOL/OSHA

Similarly:

3.64%	showed	VC	levels	greater	than	50	ppm
4.55%	"	"	"	"	"	40	"
11.8%	"	"	"	"	"	25	"
30.0%	"	"	"	"	"	10	"
42.7%	"	"	"	"	"	5	"
81.8%	"	"	"	"	"	1	"

EXHIBIT B - 6(4)
USDOL/OSHA

Table III -- Distribution of 8-HR TWA Levels

May 15 - June 11, 1974

Median 4.9 ppm
Range < 0.1 -- 27.9 ppm

10%	of	employes	had	TWA	values	of	1.2	ppm	or	less
20%	"	"	"	"	"	"	1.5	"	"	"
30%	"	"	"	"	"	"	2.3	"	"	"
40%	"	"	"	"	"	"	3.2	"	"	"
50%	"	"	"	"	"	"	4.9	"	"	"
60%	"	"	"	"	"	"	5.9	"	"	"
70%	"	"	"	"	"	"	7.8	"	"	"
80%	"	"	"	"	"	"	10.2	"	"	"
90%	"	"	"	"	"	"	14.0	"	"	"
95%	"	"	"	"	"	"	21.1	"	"	"
97.5%	"	"	"	"	"	"	27.9	"	"	"

EXHIBIT B - 6(5)
USDOL/OSHA

Similarly:

None	had	TWA	values	greater	than	50	ppm
2.2%	"	"	"	"	"	25	"
22.2%	"	"	"	"	"	10	"
44.5%	"	"	"	"	"	5	"
91.1%	"	"	"	"	"	1	"

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EXHIBIT B - 6 (6)
USDOL/OSHA

Table IV

Job Classification	Number of Values	Vinyl Chloride -- ppm as TWA		
		Median	Low	High
*Reactor Cleaner	21	6.3	1.4	27.9
*Poly Area Operator	4	11.4	4.2	23.7
*Outside Operator	4	3.4	1.9	14.3
Finish. Bldg. Operator	5	1.6	0.4	3.2
Loading Rack Operator	4	3.6	1.2	9.6
Control Room Operator	4	0.9	<0.1	6.0
Supervisor	2	3.7	2.5	4.9
Tech. Supt. (in plant)	1	6.9	Not Applicable	
TOTAL	45	4.9	< 0.1	27.9

*TWA mean for reactor building 8.5 ppm -- range 1.4 to 27.9 ppm

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Notes: (1) Concentration measurements were obtained from samples taken in 250 ml. glass tubes. Aliquots of these samples were injected directly into a gas chromatograph. Samples absorbed on carbon were desorbed in carbon disulfide prior to injection into the chromatograph.

(2) Four samples only

(3) One sample only

Sou ce: Snell summary of industry data

EXHIBIT B-7(1)
USDOL/OSHA
MONITORING RESULTS FOR
22-M-OLD-C

VINYL CHLORIDE LEVELS

TABLE I

VCM TEST METERS

1946-1967	MSA Explosimeter Lowest reading on scale, 2% of LEL, or 720 ppm - not accurate at this level.
1968-1971	Davis Vaportester Lowest reading on a X10 scale was 0.2% of LEL or 72 ppm - not accurate at this level.
1972-1973	Johnson & Williams SS PK Tester Scale reads 26 ppm per division but not accurate below 50 ppm. Zero drift often in excess of 50 ppm.
1974	Century OVA #98 Portable FID Testers Not specific for VCM. Reads down to 1 ppm. We calibrate with certified gas at 50 and at 5 ppm.

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TABLE 2

EXHIBIT B -7(2)
USDOL/OSHA

Vinyl Chloride Levels in Operating Buildings

Time Span		C-1	C-2	E-1	E-2	F-1	F-3	K
1946-1972	TWA	500	140	500	150	20	-	-
1973	Number of Readings	77	73	582	597	222	73	85
	TWA (ppm)	50	5	50	25	125	5	175
	Maximum reading (ppm)	2800	200	3000	2800	2460	200	2240
Jan, 1974	Number of Readings	9	9	63	80	27	8	9
	TWA (ppm)	64	8	25	17	93	44	17
	Maximum Reading (ppm)	300	60	504	168	840	300	100
April 8, 1974 to May 21, 1974	Number of Readings*	306	131	935	1068	528	328	132
	TWA (ppm)	8	4	7	6	10	8	7
	Maximum Reading (ppm)	246	35	43	34	50	65	46

*Exclusive of Reactor Cleaning.

Work Functions:
C-1 - Tank Car Unloading, VC pumping, VCM production until 1967
C-2 - " " " " " " " "
E-1 - Polymerization, Monomer Recovery
E-2 - " " "
F-1 - Filter, Apron driers
F-3 - Filter, Rotary drier
K - Filter, Spray drier

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Table 3 -- Area Sampling Results --
April 8 - June 27, 1974

EXHIBIT B-7(3)
USDOL/OSHA

(Century OVA Meter)

Building Readings

Time Period - 1974	Upwind Reading	E-1	E-2	F-1	C-1	C-2	K	F-3
Average of All Readings (as ppm Vinyl Chloride)								
4/8-4/17	4.9	14.7	12.6	-	38.9	9.1	14.2	14.7
4/27-5/7	6.2	11.7	11.4	-	10.1	10.6	14.2	12.8
5/17-5/25	4.8	9.3	9.2	-	6.7	7.9	10.3	10.9
6/5-6/13	3.7	7.0	7.9	8.2	5.5	5.7	6.2	10.5
6/14-6/27	3.8	7.6	7.7	9.2	5.5	6.0	7.3	7.0
4/8-6/27	4.8	10.5	9.7	13.1	7.2	7.9	10.5	11.6
Number of Readings	240	1678	1229	398	310	153	154	215

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EXHIBIT B-7(4)
USDOL/OSHA

Table 3 (continued)

Maximum Reading Recorded (as ppm Vinyl Chloride)

4/8-4/17	7	45	32	-	500	30	45	42
4/27-5/7	13	28	40	-	24	40	49	33
5/17-5/25	18	35	40	-	21	22	27	45
6/5-6/13	6	20	35	40	10	10	16	55
6/14-6/27	5	27	45	35	12	11	50	20
4/8-6/27	18	50	45	275	500	40	50	55

Note: These data do not cover excursions, but represent routine conditions.

Table 4 -- Vinyl Chloride Levels

EXHIBIT B-7(5)
USDOL/OSHA

April 8 -- June 27, 1974

Time Period - 1974	Century OVA Readings as ppm Vinyl Chloride					
	Average*		Maximum*		Mimimum*	
	E-1	E-2	E-1	E-2	E-1	E-2
4/8-4/17	33.0	27.1	115	35	15	14
4/18-4/26	27.5	--	40	--	15	--
4/27-5/7	29.8	33.1	48	46	6	15
5/8-5/16	34.2	--	45	--	10	--
5/17-5/25	25.9	29.8	46	45	7	10
5/26-6/4	20.8	--	45	--	7	--
6/5-6/13	21.8	31.0	41	60	4	15
6/14-6/27	20.3	29.7	40	48	5	10
4/8-6/27	26.5	30.6	115	60	4	10

* A total of 193 readings were taken in E-1 reactors; 98 readings in E-2 reactors.

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EXHIBIT B-7(6)
USDOL/OSHA

Table 5 -- Personnel Monitoring Data --

April 17 -- June 28, 1974

Description of Value		250 ml Glass	10 min Carbon	All Short-Term Samples	8-HR TWA
Number of Samples		94	74	168	31
Minimum Value -- ppm		0.1	Nil	Nil	< 0.04
Maximum Value -- ppm		160	55	160	100
VCM (ppm) --	10% of samples	0.6	< 1	< 1	3
	20 " "	1	< 1	< 1	4
	30 " "	2	1	1.8	5
	40 " "	2	2	2	8
	50 " "	3	3	3	12
	60 " "	5	3.8	5	14
	70 " "	7	6	6	16
	80 " "	12	9	10	20
	90 " "	22	12	15	24
	95 " "	42	25	37	28
	97.5 " "	60	44	55	100

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EXHIBIT B -7(7)
USDOL/OSHA

Table 5 (continued)

Percentage of values above 50 ppm	4.3	1.4	3.0	6.5
" " " " 40 "	6.4	2.7	4.8	6.5
" " " " 25 "	9.6	4.1	7.1	9.7
" " " " 10 "	20.2	16.2	18.5	51.7
" " " " 5 "	39.4	31.6	35.7	67.8
" " " " 1 "	73.4	66.2	70.2	93.7

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EXHIBIT B-7(8)
USDOL/OSHA

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Table 6 -- Distribution of Personnel Monitoring Data By Job Function and/or Area

Work Area or Function	Ten Minute-Glass & Carbon Tubes: Total Samples	No. > 40 ppm	No. > 25 ppm	Vinyl Chloride Ave ppm	Vinyl Chloride Max ppm	Vinyl Chloride Min ppm	8-HR TWA: Total Samples	No. > 25 ppm	No. > 10 ppm	Vinyl Chloride Ave ppm	Vinyl Chloride Max ppm	Vinyl Chloride Min ppm
Reactor Cleaning	20	6	9	33.1	160	2	6	0	5	15.7	22	8
Batch Transfer	23	1	2	8.3	75	1	3	0	1	7.7	12	4
Reactor Area	23	0	0	5.0	22	1	5	0	2	10.0	24	3
Pump Room	12	0	0	5.8	9	< 1	1	0	0	5.0	--	--
Control Room	11	0	0	6.0	12	2	2	1	1	18.0	28	9
E-Bldg. Supervisor	--	--	--	--	--	--	3	1	1	22.0	51	4
Bagger	13	0	0	4.9	13	< 1	2	0	0	4.5	6	3
P&S Dryer	9	1	1	14.6	60	3	3	0	3	17.3	24	13
Break Room	7	0	0	1.2	2	< 1	--	--	--	--	--	--
Locker Room	7	0	0	1.3	2	0.4	--	--	--	--	--	--
Lunch Room	6	0	0	1.8	7	Nil	--	--	--	--	--	--
Main Office	7	0	0	1.7	5	Nil	1	0	0	< 0.04	--	--
Warehouse	7	0	0	2.0	5	< 1	2	0	0	2.1	3.6	0.6
Telex	10	0	0	1.3	10	< 0.1	--	--	--	--	--	--
Laboratory	6	0	0	0.6	1	Nil	--	--	--	--	--	--
Maintanance Shop	7	0	0	0.6	2	0.1	--	--	--	--	--	--
Shift Monitor	--	--	--	--	--	--	3	1	3	44.0	100	16

Source: Snell summary of industry data

EXHIBIT B-8

USDOL/OSHA

MONITORING RESULTS FOR

31-M-MEW-C

Location	Total Employees	Current Estimated VCM Exposure Levels (PPM) (1)
. Outside, Tank Car Unloading	1	0 - 5
. Outside, Storage Area	1	0 - 5
. Reactor Building	60	25 - 30 (w/excursions to 50)
. Centrifuge and Dryer Building	8	0 - 5
. Outside, PVC Silos	6	~0 - 5
. Bulk Pack Bagging Building	6	~0 - 5
. Bagging Warehouse	15	~0 - 5

Note:

(1) Monitoring performed with Ovameter

Source: Snell summary of industry data

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EXHIBIT B-9

USDOL/OSHA

MONITORING RESULTS FOR

45-M-INT-C

Unit Operation	Current Range VCM (PPM)	How Measured
VC Unloading (1)	0 - 200	Gas Chromatograph
Polymerization	10 - 50	Gas Chromatograph
Kettle Cleaning (1)	10 - 175	Gas Chromatograph
Drying	5 - 40	Gas Chromatograph
Packaging (1)	5 - 125	Gas Chromatograph
Shipping	0 - 70	Gas Chromatograph

Note: (1) Type C continuous flow air masks required while performing this function.

Source: Snell summary of industry data

EXHIBIT B-10
USDOL/OSHA

MONITORING RESULTS FOR

30-M-NEW-C

Unit Operation	Current VC, PPM	How Measured	Historical VC, PPM	How Measured
1. VC Unloading	<50	GC		
2. Prepolymerizer			<200	Odor (1)
Charging	20 - 40	GC		
Opening	>100	GC		
Cleaning	25 - 100	GC		
3. Postpolymerizer				
Charging	<25	GC		
Opening	50 - 150	GC		
Cleaning	<50	GC		
Transfer	>50	GC		
4. Bagging	<50	GC		

Note: (1) Not a reliable measurement

Source: Snell summary of industry data

EXHIBIT B-11
USDOL/OSHA

MONITORING RESULTS FOR

41-L-OLD-W

Job Description	Number of Samples	Average Worker Exposure to VCM in PPM	Range of Worker Exposure to VCM in PPM
Maintenance	42	1.9	<0.1 - 26.6
Poly Scrubber	16	14.4	2 - 49.7
Lab Technician	13	184.1	0.2 - 2375
Bagger	6	2.5	0.1 - 8.4
Compounding Operator	19	1.7	0.1 - 8.7
Dryer Operator	34	78.8	0.5 - 915.7
HRC Operator	10	3.8	<1.0 - 18.4
Head Operator	17	4.9	1.0 - 26.4
Poly Head Operator	21	6.6	0.3 - 45.9
Poly Drop Operator	26	5.7	0.9 - 52.7
Drop Operator	6	2.5	1.0 - 5.6

Note: Snell average of data for the months of March through June 1974.

Source: Snell summary of industry data

EXHIBIT B-12
USDOL/OSHA

MONITORING RESULTS FOR

28-L-NEW-C

Unit Operation	Current VCM Concentration Since July, 1974 (PPM)	How Measured	Historical VCM Concentration Since April, 1974 (PPM)	How Measured
. Polymerization and	5 - 10	FID [1]	7 - 90	FID
Setting	11 - 10	Carbon Tube	20 - 130	Carbon Tube
. Centrifugation	100 - 160	FID	100 - 160	FID
. VC Recovery and	7 - 180	FID	Up to 10,000	FID
Unloading	27	Carbon Tube	Up to 10,000	Carbon Tube
. Reactor Entry For Cleaning	4 - 42	Carbon Tube	40 - 200	FID
. Transfer and Loading	0 - 3	FID	0 - 3	FID
. Warehousing	0 - 3	FID	0 - 3	FID

Note:

(1) FID = Flame Ionization Detector

Source: Snell summary of industry data

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EXHIBIT B-13(1)
USDOL/OSHA

MONITORING RESULTS FOR
54-M-NEW-C

Job/Location	No. of Data Points	Vinyl Chloride Monomer Concentrations (PPM) Avg.(1)	High	Low
Scrubbing	20	65	199	8
Bagger and Bag Operators	17	20	70	0.4
Operator and Operator Workmen	72	24	239	0.6
Control Man/Control Room	27	27	343	0.2
Sampling and Checking	26	61	1021	0.3
Reclaim Operator	7	55	227	3
Waste Lake	2	2	4	0.8
Maintenance	17	10	34	0.2
Washing and Cleaning	42	65	1389	0.3
Perimeters	48	2	11	0.5
Loading Operators	16	31	213	0.6
River Discharge	1	1	X	X
Dicer	6	3	8	0.5
Dropping and Charging	23	70	671	0
Blending and Milling/Mill	9	6	36	0.6
Intakes, Exhausts, Vents	9	22	104	0.4
Dust Collectors	10	16	76	1
Office Areas	7	2	4	0.3
Work Areas and Decks	33	8	74	0.7
Dryers and Vicinity	7	51	168	0.8
Product Collectors	2	10	16	3
FCM Rotors	2	1827	2141	1512

EXHIBIT B-13(2)
USDOL/OSHA

Notes:

X = Not Applicable

(1) Snell averaging of reported data.

Source: Snell summary of industry data

EXHIBIT B-14 (1)
USDOL/OSHA

MONITORING RESULTS FOR
5-L-OLD-C

Atmospheric Concentration Vinyl Chloride During Cleaning of 4,000 Gal.

Suspension Process

Sample Location	Air Concentration Vinyl Chloride ppm
1. Operator breathing zone when entering polymerizer	19
2. Operator breathing zone while scraping walls of polymerizer	22
3. Operator breathing zone while scraping walls of polymerizer	19

August-September 1967

Monomer Concentration in Polymerizer Atmospheres

Polymer Type	Poly No.	Poly Size	Total Evacuation Time	VCl ppm Monomer 10 Min.*	30 Min.**
Suspension	120	1100	20"	84	72
"	130	1100	18"	50	46
"	151	1100	25"	42	32
"	102	1100	35"	99	78
"	124	1100	20"	230	123
"	128	1100	20"	77	80
"	150	1100	50"	20	25
"	150	1100	20"	76	80
"	121	1100	40"	34	34
"	128	1100	40"	104	63
"	136	1100	45"	56	62

EXHIBIT B -14 (2)
USDOL/OSHA

"	130	1100	90"	93	32
"	133	1100	25"	146	97
"	114	1100	25"	375	250
"	113	1100	30"	147	107
"	117	1100	25"	234	264
"	135	1100	25"	180	185
"	132	1100	40"	147	104
"	136	1100	40"	118	64
"	116	1100	60"	76	59
Dispersion	25	1100	22"	74	100
"	32	1100	20"	56	114
"	29	1100	30"	34	84
"	48	1100	25"	417	391
"	28	1100	55"	36	68
"	45	1100	55"	78	100
"	42	1100	60"	100	189
"	43	1100	25"	75	148
"	32	1100	30"	211	279
"	25	1100	35"	55	39
"	6	1100	25"	102	37
"	25	1100	30"	62	41
"	19	1100	25"	94	88
"	34	1100	25"	40	29
"	6	1100	40"	35	44
"	20	1100	30"	165	168
"	9	1100	25"	120	99
"	12	1100	25"	60	78
"	4	1100	30"	271	152

EXHIBIT B-14(3)
USDOL/OSHA

August-September 1967

Monomer Concentration in Polymerizer Atmospheres
con't.

Polymer Type	Poly No.	Poly Size	Total Evacuation Time	VCl ppm Monomer 10 Min.*	30 Min.**
Dispersion	8	1100	60"	27	80
"	12	1100	25"	174	320
"	21	1100	18"	102	104
"	12	1100	30"	142	168
"	17	1100	35"	38	68
Suspension	137	3300	20"	374	134
"	143	3300	45"	405	142
"	137	3300	25"	62	112
"	141	3300	35"	138	123
"	113	1100	15"	54	59
"	127	1100	10" & 30"	32	498
"	116	1100	10" & 5"	440	390
"	106	1100	30"	192	188
"	146	3300	30"	162	200
"	142	3300	35"	147	139
"	124	1100	30"	128	101
"	142	3300	35"	106	113
"	105	1100	30"	52	47
"	148	3300	45"	26	24

* Sample collected 10 minutes after operator enters poly, operator breathing zone sample.

**Sample collected 30 minutes after operator enters poly or after cleaning, if cleaning time was less than 30 minutes; operator breathing zone sample.

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EXHIBIT B-14(4)
USDOL/OSHA

Monomer Concentration in Room Air
ppm VC

Date	Dispersion Resin Bldg. 451	Suspension Resin Bldg. 461
8-29-67		53
9-5-67	16	27
9-7-67	58	45
9-11-67		26
9-12-67	450	18
9-25-67		31
9-26-67		48
9-28-67	6	32

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EXHIBIT B-14(5)
USDOL/OSHA

Monomer Concentration in Polymerizer Atmospheres
October 1967

Polymer Type	Poly No.	Poly Size	Total Evacuation Time	VCl ppm Monomer 10 Min.	30 Min.
Suspension	25	1100	65"	71	95
"	43	1100	45"	59	50
"	33	1100	45"	48	70
"	29	1100	35"	73	117
"	41	1100	35"	75	38
"	25	1100	30"	73	98
"	30	1100	65"	66	114
"	45	1100	80"	30	23
"	34	1100	65"	35	43
"	46	1100	35"	56	55
Dispersion	16	1100	50"	115	210
"	18	1100	20"	156	114
"	14	1100	50"	53	74
"	18	1100	35"	58	62
"	2	1100	25"	58	56
Suspension	142	3300	45"	50	35

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EXHIBIT B-14 (7)
USDOL/OSHA

		72		
			88	
			65	
			76	
	10-8	28		
		133		
	10-30			
	11-12		24	
			18	
			62	
			61	
			63	
	~~11-13~~			14
				27
				15
				7
	11-19			13
			29	
			73	
1972	6-29			
			<1	
			<1	
			3	
			16	
			<1	
			41	
Average		72	38	16

EXHIBIT B-14(8)
USDOL/OSHA

Atmospheric Vinyl Chloride Concentrations in Charging Area

Dispersion Resin
Building 451

Tuesday, 8-22-72; 11 a.m.

West Side	82 ppm
East Side	155 ppm
Control Room	8 ppm

Tuesday, 8-22-72; 3 p.m.

West Side	89 ppm
East Side	378 ppm
Control Room	64 ppm

Thursday, 8-24-72; 9 a.m.

West Side	78 ppm
East Side	13 ppm
Control Room	5 ppm

Thursday, 8-24-72; 11 a.m.

West Side	73 ppm
Center	104 ppm
East Side	30 ppm

Thursday, 8-24-72; 1 p.m.

West Side	97 ppm
Center	72 ppm
East Side	10 ppm

EXHIBIT B-14-(9)
USDOL/OSHA

Thursday, 8-24-72; 3 p.m.

West Side	33 ppm
Center	33 ppm
East Side	13 ppm

Friday, 8-25-72; 9 a.m.

West Side	135 ppm
Center	22 ppm
East Side	148 ppm

Friday, 8-25-72; 11 a.m.

West Side	24 ppm
Center	24 ppm
East Side	131 ppm

Dispersion Resin
Building 451
con't.

Friday, 8-25-72; 1 p.m.

West Side	47 ppm
East Side	95 ppm
Control Room	54 ppm

Thursday, 9-7-72; 1 p.m.

West Side	23 ppm
East Side	440 ppm

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EXHIBIT B-14 (10)
USDOL/OSHA

Suspension Resin
Building 461

Tuesday, 8-22-72; 11 a.m.

West Side	531 ppm
East Side	131 ppm
Control Room	49 ppm

Tuesday, 8-22-72; 3 p.m.

West Side	48 ppm
East Side	32 ppm
Control	24 ppm

Thursday, 8-24-72; 9 a.m.

West Side	29 ppm
East Side	288 ppm
Control Room	26 ppm

Thursday, 8-24-72; 11 a.m.

West Side	329 ppm
Center	762 ppm
East Side	70 ppm

Thursday, 8-24-72; 1 p.m.

West Side	20 ppm
East Side	72 ppm

Thursday, 8-24-72; 3 p.m.

West Side	33 ppm
Center	107 ppm
East Side	87 ppm

EXHIBIT B-14(11)
USDOL/OSHA

Friday, 8-25-72; 9 a.m.

West Side	369 ppm
Center	364 ppm
East Side	135 ppm

Suspension Resin
Building 461

Friday, 8-25-72; 11 a.m.

West Side	168 ppm
Center	186 ppm
East Side	156 ppm

Fri

Friday, 8-25-72; 1 p.m.

West Side	358 ppm
East Side	122 ppm

Thursday, 9-7-72; 1 p.m.

West Side	51 ppm
East Side	74 ppm

Suspension Resin
Building 464

Tuesday, 8-22-72; 11 a.m.

North End	82 ppm

Tuesday, 8-22-72; 3 p.m.

North End	5 ppm
Center	32 ppm
South End	32 ppm

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EXHIBIT B-14(12)
USDOL/OSHA

Thursday, 8-24-72; 9 a.m.

North End	8 ppm
Center	13 ppm
South End	5 ppm

Thursday, 8-24-72; 11 a.m.

North End	5 ppm
Center	7 ppm
South End	7 ppm

Thursday, 8-24-72; 1 p.m.

North End	5 ppm
Center	15 ppm
South End	15 ppm

Thursday, 8-24-72; 3 p.m.

North End	7 ppm
Center	47 ppm
South End	67 ppm

Suspension Resin
Building 464

Friday, 8-25-72; 9 a.m.

North End	36 ppm
Center	9 ppm
South End	9 ppm

Friday, 8-25-72; 11 a.m.

North End	24 ppm
Center	12 ppm
South End	36 ppm

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EXHIBIT B-14(13)
USDOL/OSHA

Friday, 8-25-72; 1 p.m.

North End	47 ppm
Center	108 ppm
South End	115 ppm

Area Measurements Using Portable and Fixed Instrumentation, Measuring Total Hydrocarbons by the Flame Ionization Method

Building	Product	Month	Average ppm	% Readings Above 50 PPM	% Readings Under 10 PPM
451	Dispersion Resin	JAN. 74	29.5	3.5	8.7
		FEB. 74	23.7	3.9	14.4
		MAR. 74	15.3	2.6	23.4
		APR. 74	17.1	4.9	42.9
		MAY 74	17.8	2.7	65.2
		JUNE 74	11.3	4.7	72.5

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EXHIBIT B-14(14)
USDOL/OSHA

461	Suspension Resin	JAN. 74	25.6	4.7	24.1
		FEB. 74	17.8	3.3	37.9
		MAR. 74	19.1	2.5	21.7
		APR. 74	18.7	3.4	14.6
		MAY 74	15.4	2.2	59.3
		JUNE 74	11.9	4.9	57.8
464	Suspension Resin	JAN. 74	31.4	5.1	11.1
		FEB. 74	22.7	3.1	10.3
		MAR. 74	18.3	1.1	34.8
		APR. 74	12.7	0.0	58.9
		MAY 74	8.8	2.8	71.2
		JUNE 74	6.0	2.8	82.5
463	PVC Latex	JAN. 74	8.1	0.0	70.9
		FEB. 74	8.2	0.2	91.7
		MAR. 74	7.6	0.0	97.5
		APR. 74	7.6	0.7	97.6
		MAY 74	9.6	0.4	86.3
		JUNE 74	8.1	1.9	82.3

EXHIBIT B-14 (15)
USDOL/OSHA

PERSONNEL MONITORING DATA - MAY-JULY, 1974

			TWA	PPM VCl	
Location and Type	Operation	No. of Samples	Average	Maximum	Minimum
East Bldg. 464 Suspension Resin	Charging	5	10	23	3
	Cleaning	4	12	23	2
	Recovery	6	14	31	3
West Bldg. 451 Dispersion Resin	Charging	5	8	18	4
	Cleaning	7	19	42	6
	Recovery	3	9	15	3
	Drying and Bagging	4	1	2	1
West Bldg. 461 Suspension Resin	Charging	3	10	22	3
	Cleaning	6	22	80	5
	Recovery	4	17	26	6
	Supervisory	1	12		
West Bldg. 453 Latex	Charging	4	14	23	2
	Cleaning	3	47	126	4
	Recovery	2	80	154	6
	Supervisory	1	3		

Notes:
Everyone wears respiratory equipment where the work atmosphere is greater than 25 ppm or where operations and experience show there is a risk of exceeding 25 ppm.

Personnel monitoring samples are taken over a period of time generally 4 hours (some data represents 20 minute samples) to obtain the time weighted average for employee exposure. All samples are collected by absorption on carbon tubes and tested using gas chromatography.

Source: Shell summary of industry data

EXHIBIT B-15(1)
USDOL/OSHA

MONITORING RESULTS FOR
8-L-NEW-C

Atmospheric Concentrations of Vinyl Chloride - Building 731

Sample Location	Vinyl Chloride Concentration (ppm)
Near Manhole, Poly No. 2 - Suspension Resin	15
Near Manhole, Poly No. 7 " "	18
Near Manhold, Poly No. 11 " "	24
Near Manhold, Poly No. 21 - Dispersion Resin	34

Atmospheric Concentrations of Vinyl Chloride 2nd Floor Bldg. 731

Tuesday, April 4	VCl ppm
12:50 PM	
Aisleway paste* line proceeding North to South Poly #36 & 35	102
Aisleway paste line proceeding North to South Poly #29 & 30	98
Aisleway paste line proceeding North to South Poly #22 & 21	41
1:05 PM	
Aisleway pearl* line proceeding North to South Poly #15 & 17	268
Aisleway pearl line proceeding North to South Poly #9 & 11	271
Aisleway pearl line proceeding North to South Poly #3 & 5	124
1:30 PM	
Aisleway pearl line proceeding North to South Poly #15 & 17 (approx.)	737
Aisleway pearl line proceeding North to South Poly #9 & 11	76
Aisleway pearl line proceeding North to South Poly #3 & 5	58

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EXHIBIT B-15 (2)
USDOL/OSHA

2:58 PM to 3:02 PM

Aisleway pearl line proceeding North to South Poly #9 & 10 (Approx.)	550
Aisleway pearl line proceeding North to South Poly #2 & 1	62
Outside control room by metering station	260

3:53 PM

Aisleway pearl line proceeding North to South Poly #15 & 17	40
Aisleway pearl line proceeding North to South Poly #9 & 11	50
Aisleway pearl line proceeding North to South Poly #3 & 5	5
Outside control room by metering station	30

4:15 PM

Aisleway paste line proceeding North to South Poly #36 & 35	68
Aisleway paste line proceeding North to South Poly #22 & 21	68
Aisleway paste line proceeding North to South Poly #15 & 17	58
Outside control room by metering station	55

4:25 PM

Aisleway paste line between Poly #36 & 35	68
Outside control room by metering station	35

4:[illegible] PM

Aisleway paste line proceeding North to South Poly #36 & 35	39
Aisleway paste line proceeding North to South Poly #29 & 30	48
Aisleway paste line proceeding North to South Poly #22 & 21	39
Aisleway pearl line at South end of Poly #3 & 5	45

* "Paste" means dispersion resin
"Pearl" means suspension resin

EXHIBIT B -15(3)
USDOL/OSHA

Atmospheric Concentrations of Vinyl Chloride
2nd Floor Bldg. 731

Wednesday, April 5	VCl ppm
12:13 PM to 12:19 PM	
Just inside doorway to 2nd floor poly area	250
Aisleway paste* line proceeding North to South Poly #35 & 36	318
Aisleway paste line proceeding North to South Poly #30 & 29	462
Aisleway pearl* line proceeding North to South Poly #20 & 19	332
Aisleway pearl line proceeding North to South Poly #14	474
Aisleway pearl line proceeding North to South Poly #4	122
12:42 PM to 12:48 PM	
Inside control room	15
Outside control room by metering station	130
Aisleway pearl poly line between Polys #9 & 10	130
Doorway to compound room near freight elevator	145
Aisleway paste poly line by Poly #24	133
By Bldg. exit door located behind control room	117
3:00 PM to 3:06 PM	
Inside control room	5
Outside control room by metering station	45
Aisleway pearl line; North end by Polys $15 & 16	38
Aisleway pearl line; South end by Polys #1 & 2	23
Aisleway paste line; North end by Polys #33 & 34	90
Aisleway paste line; South end by Polys #21 & 22	108

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EXHIBIT B-15 (4)
USDOL/OSHA

3:30 PM to 3:40 PM

At manhead to pearl Poly #6; just off recovery, fumes seen venting to room (approx.)	550
In aisleway in front of pearl Poly #6	438
At manhead to pearl Poly #2; exhaust hose had just been removed	470
At manhead to paste poly #34; after HRC cleaning	400
At manhead to paste Poly #30; poly filled with cleaning solution	5
In aisleway between paste Polys #27 & 38	5

5:00 PM to 5:15 PM

Inside control room	10
Outside control room by metering station	45
Aisleway pearl line proceeding North to South Polys $15 & 16	40
Aisleway pearl line proceeding North to South Polys #5 & 6	15
Aisleway paste line proceeding North to South Polys #35 & 36	77
Aisleway paste line proceeding North to South Polys #21 & 22	65

* "Paste" means dispersion resin
"Pearl" means suspension resin

Atmospheric Concentrations of Vinyl Chloride In Bldg. 731

Thursday, April 6

9:30 AM to 9:40 AM

	VCl ppm
Inside control room	2
Outside control room by metering station	8
Aisleway pearl* line proceeding North to South Polys #19 & 20	148
Aisleway pearl line proceeding North to South Polys #1 & 2	268
Aisleway paste* line proceeding North to South Polys #35 & 36	25
Aisleway paste line proceeding North to South Polys #21 & 22	45

EXHIBIT B-15(5)
USDOL/OSHA

10:45 AM to 11:00 AM

Inside control room	15
Outside control room by metering station	28
Aisleway pearl line proceeding North To South Polys #19 & 20	25
Aisleway pearl line proceeding North to South Polys #14 & 13	28
Aisleway pearl line proceeding North to South Polys #3 & 4	27
At manhead pearl Poly #8; opened for cleaning	300
Aisleway paste line proceeding North to South Polys #35 & 36	30
Aisleway paste line proceeding North to South Polys #31 & 32	30
Breathing zone of man hose washing #25 paste poly	100
Aisleway by paste premix poly	18

1:45 pm to 2:05 PM

Outside control room by metering station	32
By doorway to compounding room; near freight elevator	27
Aisleway pearl line proceeding North to South Polys #15 & 16	14
Aisleway pearl line proceeding North to South Polys #3 & 4	30
At manhead of pearl Poly #9	33
At manhead of pearl Poly #14	22
Aisleway paste line proceeding North to South Polys #33 & 34	30
Aisleway paste line proceeding North to South Polys #29 & 30	26
Aisleway paste line proceeding North to South Polys #23 & 24	31
At manhead paste Poly #31	163
At manhead paste Poly #34	168
By bldg. exit door behind control room	35
On mezzanine level by #9 blowdown tank	20
On mezzanine level by #6 blowdown tank	31
On Mezzanine level at South end paste blowdown area	26

* "paste" means dispersion resin
"pearl" means suspension resin

EXHIBIT B-15(6)
USDOL/OSHA

Thursday, April 6 -- Con't.	VC1 ppm
8:40 PM to 8:50 PM	
Outside control room by metering station	108
At doorway to compound room; near freight elevator	95
Aisleway pearl line proceeding North to South Polys #15 & 16	43
Aisleway pearl line proceeding North to South Polys #5 & 6	72
Aisleway paste line proceeding North to South Polys #33 & 34	98
Aisleway paste line proceeding Nor5h to South Polys #23 & 24	91

EXHIBIT B -15 (7)
USDOL/OSHA

VCL MONITORING DATA

Area Measurements Using Portable and Fixed Instrumentation, Measuring Total Hydrocarbons by the Flame Ionization Method

Building	Product	Month	Average	% Readings Above 50 PPM	% Readings Under 10 PPM
			ppm		
731	Suspension	JAN. 74	90.7	33.0	20.3
	and	FEB. 74	31.4	10.0	17.4
	Dispersion	MAR. 74	18.3	2.0	27.9
	Resins	APR. 74	16.8	4.8	69.1
		MAY 74	8.6	2.3	82.0
		JUNE 74	8.3	2.9	79.1

EXHIBIT B -15 (8)
USDOL/OSHA

PERSONNEL MONITORING DATA

May - July, 1974

Location and Type	Operation	No. of Samples	TWA PPM VCl Average	Maximum	Minimum
	Charging	7	6	13	2
Suspension Resin	Cleaning	7	4	8	2
	Recovery	4	6	9	4
	Charging	5	5	8	2
Dispersion Resin	Cleaning	3	12	26	2
	Recovery	3	4	5	3

Everyone wears respiratory equipment where the work atmosphere is greater than 25 ppm or where operations and experience show there is a risk of exceeding 25 ppm.

Personnel monitoring samples are taken over a period of time generally 4 hours to obtain the time weighted average for employee exposure. All samples are collected by absorption on carbon tubes and tested using gas chromatography.

Source: Snell summary of industry data

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EXHIBIT B-16 (1)
USDOL/OSHA

MONITORING RESULTS FOR

49-M-OLD-C

CHROMATOGRAPHIC ANALYSIS DATA

Ambient Concentrations Vinyl Chloride, ppm

Year	Date	COPOLYMER RESIN Building 15 3rd Floor	SUSPENSION RESIN Building 1	SUSPENSION RESIN Building 111	DISPERSION RESIN & LATEX Building 121 3rd Floor
1965	10-27	24			
		17			
	11-10	117			
	11-10	51			
	11-11	183			
		182			
	12-8	99			
	12-10	75			
1966	1-10	47			
	1-12	30			
	1-13	18			
	1-14	2			
		38			
		98			
		97			
		68			
	9-2	55			
		28			
	9-13	111			

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EXHIBIT B-16 (2)
USDOL/OSHA

Year	Date	COPOLYMER RESIN Building 15 3rd Floor	SUSPENSION RESIN Building 1	SUSPENSION RESIN Building 111	DISPERSION RESIN & LATEX Building 121 3rd Floor
1967	2-8	26			
	2-14	32			
	2-15	12			
	2-17	24			
	12-9	28	41	80	231
					632
	11-2	10			
	12-11				52
					374
	12-12				110
	12-15	51			
		49			
	12-18	42			
1968	1-9				135
					130
					138
					97
					85
					81
					72
					114
	12-16	26	23	36	
	12-17	2	20	42	

EXHIBIT B-16 (3)
USDOL/OSHA

Ambient Concentrations Vinyl Chloride, ppm

		COPOLYMER RESIN			SUSPENSION RESIN		DISPERSION RESIN & LATEX
Year	Date	Building 15 3rd Floor	Building 15 2nd Floor	Building 15 1st Floor	Building 1 3rd Floor	Building 111 3rd Floor	Building 121 3rd Floor
1969	1-31	194					
	2-3	52					
	2-14	12					
	3-26	199					
	9-30	77					
		58					
1972	3-21	4			1	0.5	2
		1			1	0.5	4
					0.5	1	1
						7	1
						1	6
							0.5
	3-22	4			7	7	6
		1			5	3	5
		5			0.5	5	4
		2			2	10	3
		2			4	9	5
		6			4	10	3
		2			3	12	3
					1	11	6
					4	12	
1973	3-22	132	10	3			
		57	19	7			
		44	22				
		33					
		28					
		12					

EXHIBIT B-16(4)
USDOL/OSHA

Exhaust Time - 15 Min.
- 30 Min.

Polymerizer Vapor Concentrations: Vinyl Chloride, ppm

Year	Date	Copolymer Resin Building 15	Suspension Resin Building 1
1964	9-4	93	
		153	
	9-5	150	30
		120	30
		120	30
1965	3-1	310	
		145	
		150	
	10-27	28	
		31	
		77	
		134	
		29	
		21	
	11-8	55	
	11-9	48	
	11-10	132	
	12-8	92	
	12-10	32	

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EXHIBIT B -16 (5)
USDOL/OSHA

Year	Date	Copolymer Resin Building 15	Suspension Resin Building 1
1966	1-7	26	
	1-10	50	
	1-12	18	
	1-13	23	
	1-14	94	
	3-29	49	
		164	
	9-6	34	
	9-13	60	
1967	2-8	42	
	2-9	79	
	2-10	61	
	2-14	45	
	2-15	20	
	2-17	126	
	2-20	129	
		106	
	4-14	40	
	6-30	20	
	4-26	100	

EXHIBIT B-16 (6)
USDOL/OSHA

Polymerizer Vapor Concentrations: Vinyl Chloride, ppm

Year	Date	Copolymer Resin Building 15	Suspension Resin Building 1	Suspension Resin Building 111	Dispersion Resin & Latex Building 121
1967	5-15	100			
		120			
	5-16	73			
	9-8	32			
		12			
	9-14	46			
	9-18	46			
	9-27	14			
	12-4	55	75	79	628
		105	34	109	555
		75	46	122	490
		18	74	134	219
		36	34	60	
		32	55	70	
			67	100	
			58	105	
			55	30	
			59	59	
	10-26	36			
		13			
	11-1	20			
		19			
	11-2	16			
	12-18	77			

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EXHIBIT B-16(7)
USDOL/OSHA

Year	Date	Copolymer Resin Building 15	Suspension Resin Building 1	Suspension Resin Building 111	Dispersion Resin & Latex Building 121
1969	1-31	131			
	2-3	38			
	2-14	11			
	3-26	54			
	9-22	187			
		101			
	9-29	84			
		176			
		143			
	9-30	107			
		217			
1973	3-22	2			
		10			
		3			

EXHIBIT B -16 (8)
USDOL/OSHA

VCL MONITORING DATA

Area Measurements Using Portable and Fixed Instrumentation, Measuring Total Hydrocarbons by the Flame Ionization Method

Building	Product	Month	Average PPM	% Readings Above 50 PPM	% Readings Under 10 PPM
121	Dispersion Resin and Latex	JAN. 74	34.8	10.9	0.2
		FEB. 74	21.8	3.2	5.9
		MAR. 74	13.1	0.6	40.8
		APR. 74	12.4	1.7	62.0
		MAY 74	9.5	1.0	86.2
		JUNE 74	4.2	0.9	88.3
111	Suspension Resin	JAN. 74	35.6	9.1	0.2
		FEB. 74	20.8	2.0	5.9
		MAR. 74	15.6	1.5	36.0
		APR. 74	12.1	1.8	71.0
		MAY 74	8.9	1.7	90.2
		JUNE 74	3.4	1.5	90.5

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EXHIBIT B -16 (9)
USDOL/OSHA

Building	Product	Month	Average ppm	% Readings Above 50 PPM	% Readings Under 10 PPM
1	Suspension Resin	JAN. 74	24.9	3.0	0.4
		FEB. 74	18.9	0.6	7.8
		MAR. 74	16.6	1.3	21.0
		APR. 74	12.1	1.3	73.8
		MAY 74	7.1	1.2	90.9
		JUNE 74	5.5	1.1	91.2
15	Copolymers	JAN. 74	30.0	6.4	0.7
		FEB. 74	22.0	2.2	5.1
		MAR. 74	15.7	1.2	29.4
		APR. 74	13.1	2.2	64.7
		MAY 74	15.0	4.6	62.9
		JUNE 74	10.2	1.7	78.6
115	VCl Recovery Purification	JAN. 74	----	- Data Not Taken -	
		FEB. 74	27.0	3.0	0.5
		MAR. 74	29.0	5.0	9.3
		APR. 74	15.5	1.9	34.7
		MAY 74	20.2	5.4	33.3
		JUNE 74	17.6	0.8	25.2

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EXHIBIT B-16(10)
USDOL/OSHA

PERSONNEL MONITORING DATA - MAY-JULY, 1974 -

Location and Type	Operation	No. of Samples	TWA Average	PPM VCl Maximum	Minimum
Building 121 Latex and Dispersion Resin	Charging	4	5	5	2
	Cleaning	2	-	2	1
	Recovery	2	-	6	1
	Pipefitter	1	4	-	-
Building 111 Suspension Resin	Charging	2	-	19	7
	Cleaning	3	4	7	2
	Recovery	2	-	3	<.5
	Bagging and Drying	3	1	1	<.5
Building 15 Copolymer Resin	Charging	2	-	4	2
	Cleaning	2	-	11	6
	Bagging	2	-	10	7
	Pipefitter	1	14	-	-
Building 1 Suspension Resin	Charging	2	-	3	2
	Cleaning	1			1
	Recovery	3	15	42	1
	Bagging	1	3	-	-

Notes:
Everyone wears respiratory equipment where the work atmosphere is greater than 25 ppm or where operations and experience show there is a risk of exceeding 25 ppm.

Personnel monitoring samples are taken over a period of time generally 4 hours to obtain the time weighted average for employee exposure. All samples are collected by absorption on carbon tubes and tested using gas chromatography.

Source: Snell summary of industry data

EXHIBIT B-17 (1)
USDOL/OSHA

MONITORING RESULTS FOR

44-M-NEW-C

Atmospheric Vinyl Chloride Concentrations
Suspension and Dispersion Resins

Sample Description	Vinyl Chloride Concentration, ppm
Wednesday, 7-19-72; 11:20 a.m.	
North Area	
East	1.
Middle	6.
West	4.
Center Area	
East	6.
Middle	4.
West	8.
South Area	
East	27.
Middle	19.
West	6.

EXHIBIT B-17(2)
USDOL/OSHA

Wednesday, 7-19-72; 3:30 p.m.

North Area	
East	4.
Middle	6.
West	6.
Center Area	
East	4.
Middle	4.
West	4.
South Area	
East	2.
Middle	4.
West	6.

Wednesday, 7-19-72; 9:30 p.m.

North Area	
East	96.
Middle	19.
West	55.
Center Area	
East	78.
Middle	29.
South Area	
Middle	110.
West	78.

EXHIBIT B -17(3)
USDOL/OSHA

Suspension and Dispersion Resin
con't.

Thursday, 7-20-72; 10:00 a.m.

North Area	
East	16.
Middle	4.
West	8.
Center Area	
East	12.
Middle	8.
West	12.
South Area	
East	12.
Middle	20.
West	20.

Thursday, 7-20-72; 4:00 p.m.

Mass Poly Building	
Bottom of Prepoly (Charging VCl)	9.
First Level of Prepoly	6.
Second Level of Prepoly	12.
Third Level of Prepoly	
Near Vinyl Pumps (Outside)	6.
Tank Farm	
Near Vinyl Pumps	1. (N.D.)
Under Vinyl Storage Sphere	23.

EXHIBIT B-17 (4)
USDOL/OSHA

VCL MONITORING DATA

Area Measurements Using Portable and Fixed Instrumentation, Measuring Total Hydrocarbons by the Flame Ionization Method

Building	Product	Month	Average ppm	% Readings Above 50 PPM	% Readings Under 10 PPM
512	Mass Polymerization	JAN. 74	23.8	5.1	35.7
		FEB. 74	15.5	2.0	46.5
		MAR. 74	11.5	1.1	69.3
		APR. 74	10.5	0.6	76.2
		MAY 74	8.7	1.4	79.3
		JUNE 74	8.9	0.6	80.7
513	Suspension and Dispersion Resins	JAN. 74	17.1	3.8	39.1
		FEB. 74	14.5	2.4	66.0
		MAR. 74	11.0	1.0	81.3
		APR. 74	8.8	0.7	78.8
		MAY 74	9.4	1.2	75.2
		JUNE 74	8.8	0.5	75.9

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EXHIBIT B-17(5)
USDOL/OSHA

PERSONNEL MONITORING DATA

Location and Type	Operation	No. of Samples	TWA PPM VCl Average	TWA PPM VCl Maximum	TWA PPM VCl Minimum
Mass Resin	Charging	4	9	27	2
	Cleaning	5	22	46	6
	Recovery	4	11	23	2
Suspension and Dispersion Resin	Charging	7	11	20	1
	Cleaning	3	33	32	4
	Recovery	3	7	8	5
	Drying and Bagging	2	1	-	-
	Tank Farm	2	-	1	Nil

Everyone wears respiratory equipment where the work atmosphere is greater than 25 ppm or where operations and experience show there is a risk of exceeding 25 ppm.

Personnel monitoring samples are taken over a period of time generally 4 hours to obtain the time weighted average for employee exposure. All samples are collected by absorption on carbon tubes and tested using gas chromatography.

Source: Snell summary of industry data

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EXHIBIT B-18 (1)
USDOL/OSHA

MONITORING RESULTS FOR

3-M-INT-C

Sample Point Number	Location	Breathing Zone	Fans	No. Of Measurements	VCM Concentration[1] PPM Average[2]	Range High	Low
38	SE Corner, Lower Polymer Building	Facing Toward Center of Building	On	4	6	19	1
			2 Off	17	8	19	1
39	SW Corner, Lower Polymer Building	Facing Toward Center of Building	On	4	1	1	0
			2 Off	17	6	23	0
40	SW Lower Polymer Building	Fan Level, In Front of Small Exhaust Fan	On	4	6	15	1
			2 Off	17	5	28	0
41	Center of Lower Polymer Building	Breathing Zone	On	4	4	8	1
			2 Off	17	27	325	0
42	NW Lower Polymer Building	Fan Level, In Front of Small Exhaust Fan	On	4	4	8	1
			2 Off	17	15	175	0
43	NE Corner, Lower Polymer Building	Facing Toward Center of Building	On	4	3	3	0
			2 Off	17	8	38	1
44	NW Corner, Lower Polymer Building	Facing Toward Center of Building	On	4	1	3	1
			2 Off	17	7	31	0
45	Outside NE Polymer Building	Facing Toward Fan	On	21	6	43	0
46	Front of Polymer Pit - Outside	In Front of 4 ft. Fan Facing Toward Fan		21	10	32	0
47	Lower Polymer Outside	In Front of 4 ft. Fan Facing Toward Fan		21	12	115	1

EXHIBIT B-18(2)
USDOL/OSHA

Sample Point Number	Location	Breathing Zone	Fans	No. Of Measurements	VCM Concentration(1) PPM Average(2)	Range High	Range Low
48	On Slurry Platform By Shack - Westside	Breathing Zone		21	28	105	0
49	Upstairs Polymer Center of Locker Room	Breathing Zone	On	16	5	17	1
			Off	5	3	5	2
50	SE Corner, Upstairs Polymer Across From Locker Room	Breathing Zone	On	21	7	25	0
51	SE Corner Upstairs Polymer By Ice Tank	Facing Toward Center	On	21	16	134	1
52	SW Corner Upstairs Polymer	Facing Toward Center	On	3	16	22	6
52	SW Corner Upstairs Polymer	Facing Toward Center		18	17	52	2
53	Center Polymer Control Room	Breathing Zone		3	2	2	1
53	Center Polymer Control Room	Breathing Zone		18	14	101	0
54	Center of Upstairs Polymer By Reactor 307-308	Breathing Zone		21	16	100	2
55	NE Corner, Upstairs Polymer	Facing Toward Center	On	21	12	45	2
56	NW Corner, Upstairs Polymer	Facing Toward Center	On	3	7	11	4
56	NW Corner, Upstairs Polymer	Facing Toward Center	On	18	22	325	0
57	West Center Monomer Pump House	Breathing Zone	On	17	6	24	1
			Off	4	27	52	1
58	Center of Monomer Pump House	Breathing Zone	On	17	4	16	0
			Off	4	24	62	2

EXHIBIT B-18(3)
USDOL/OSHA

Sample Point Number	Location	Breathing Zone	Fans	No. Of Measurements	VCM Concentration(1) PPM		
					Average(2)	Range	
						High	Low
59	East Center Monomer Pump House	Breathing Zone	On	17	9	23	1
			Off	4	37	62	9
79	Hose Connect House on Slurry Tank Platform	Breathing Zone		16	46	186	3
80	Wind Vector Opposite Side of Property	Facing Toward Wind		5	1	1	0

Note:

(1) Measurements taken by Century Organic Vapor Analyzer

(2) Snell average of data submitted

Source: Snell summary of industry data

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EXHIBIT B-19
USDOL/OSHA

MONITORING RESULTS FOR
9-S-INT-C

Process	Exposure (1) (ppm - VCM)
VCM Tank Car	
VCM Storage	unloading - up to 100
Measuring Tanks	
Reactors	up to 100
Blowdown	
Centrifuge & Drying	25-30
Bagging	25-30

Source: Snell summary of industry data

EXHIBIT B-20(1)
USDOL/OSHA

MONITORING RESULTS FOR
42-S-INT-C

4 Shifts - Textile Workers

Classification	Number	% Exposure
Production		
Reactor Operator (clean reactor)	16	100
Dryer Operator	12	100
Lead Operator	8	100
Service Operator (material handling)	4	100
Utility Operator (reactor guard)	8	100
Maintenance		
Maintenance Workers	5	100
Instrument Maintenance (part time)	4	50 - 60
Electrical Maintenance	3	10 - 20
Supervisory and Support		
Q. C. Supervisor	1	
Q. C. Technician	4	
Engineer	4	30
Plant Manager	1	
Foreman	5	100
Safety Engineer	1	80 - 90
Lab Technician	2	
Analytical Chemist	1	
R & D Resin Chemist	2	

EXHIBIT B-20 (2)
USDOL/OSHA

Location	Level ppm
Monomer Pump Station (open air)	0
Pump House (open building)	0 - 150
Storage Tanks (underground outside)	0
Day Tank (outside)	0
Reactor Room #1	0 - 40 (30 avg.)
Reactor Room #2	35 avg.
Open Manhole - reactor (momentary)	70 - 80
Open Manhole - exhaust in place	5 - 6
Reactor during rinsing	0 - 20
Reactor during scraping	600
Screen (open once per shift)	1000
Slurry Tanks (open manhead)	3000 - 10,000
Slurry Tanks (closed)	0
Slurry Tanks while rinsing	200
Centrifuge	0 - 35
Dryers	less than 20
Bagging	0 - 100
Storage Area	
walkway	0
between bags	85
Bulk Storage Transfer Vessels	10 - 20

Source: Snell summary of industry data

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EXHIBIT B-21
USDOL/OSHA

MONITORING RESULTS FOR
14-M-INT-W

Area Measurements Using Portable and Fixed Instrumentation, Measuring Total Hydrocarbons by the Flame Ionization Method

Building	Product	Month	Average ppm	% Readings Above 50 PPM	% Readings Under 10 PPM
812	Suspension Resin	JAN. 74	27.4	2.6	25.1
		FEB. 74	14.8	1.8	24.4
		MAR. 74	18.1	2.4	57.0
		APR. 74	15.9	2.2	49.5
		MAY 74	12.4	0.5	23.1
		JUNE 74	11.2	1.3	90.7

EXHIBIT 8-22

USDOL/OSHA

AVERAGE VINYL CHLORIDE MONOMER CONCENTRATIONS (PPM) BY JOB CLASSIFICATION AND POLYVINYL CHLORIDE PLANT (1)

Job Classification	Plant															Range	
	12M-Int.-C	17S-Int.-W	19L-New-W	40L-New-W	41M-New-W	22M-Old-C	31M-New-C	41L-Old-W	28L-New-C	54M-New-C	5L-Old-C	8L-New-C	48M-Old-C	44M-New-C	Average	High	Low
VCM Unloading																	
VCM Unloaders	NA	6	40	NA	NA	NA	3	NA	NA	NA	NA	NA	NA	NA	16	40	6
PVC Production																	
Supervisors	12	6	NA	NA	4	22	NA	NA	NA	NA	7	NA	NA	NA	10	22	5
Senior Reactor Operators	NA	8	NA	1	NA	NA	NA	5	8	20	NA	NA	NA	NA	9	20	1
Reactor Operators	18	22	25	5	11	NA	30	NA	NA	20	NA	NA	NA	NA	17	30	5
Chargers	NA	19	NA	21	NA	NA	NA	7	NA	70	10	6	6	10	19	70	7
Stripper Operators	NA	17	NA	27	NA	NA	NA	NA	90	65	30	5	NA	9	35	90	5
Centrifuge Operators	NA	NA	NA	NA	NA	NA	3	NA	120	NA	NA	NA	NA	NA	NA	120	3
Dryer Operators	3	7	20	NA	NA	17	3	NA	NA	51	1	NA	NA	1	13	51	1
Utility (Cleaners, Laborers, etc.)	7	16	NA	56	6	10	NA	78	24	NA	25	8	9	25	26	78	6
Baggers	4	14	NA	13	NA	5	3	3	2	20	1	NA	5	1	7	20	1
Warehouse Operations (2)	1	7	20	17	4	NA	NA	NA	2	NA	NA	NA	NA	NA	9	20	1
Maintenance (3)	4	3	30	12	NA	NA	NA	92	NA	2	NA	NA	NA	NA	24	92	2
Laboratory																	
Professionals (4)	6	NA	NA	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	6	1
Technicians	2	1	NA	NA	NA	NA	NA	184	NA	61	NA	NA	NA	NA	62	184	1
Management and Support (5)	NA	NA	NA	1	2	<1	NA	NA	NA	2	NA	NA	NA	NA	<1	2	<1
Average of Reported Data	7	10	27	17	6	15	6	62	41	35	12	6	7	9	19	56	3

Notes: (1) Data believed to be obtained from OVA, bag samples, charcoal tube pumps or area monitoring on a mixed time basis.
(2) Includes supervisors and clerks, but based primarily on warehousemen.
(3) Includes supervisors and maintenance men.
(4) Includes supervisors and chemists.
(5) Includes plant managers, engineers and clerical personnel.

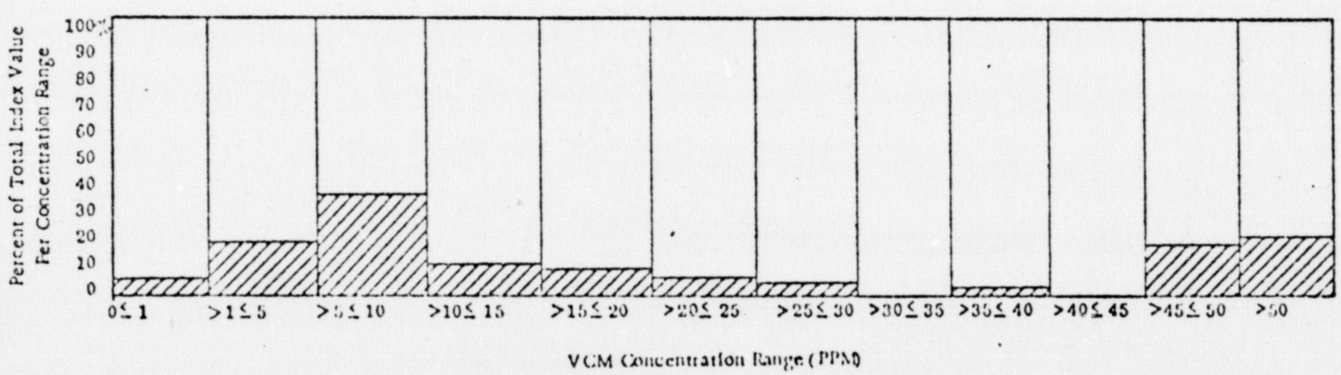
Source: Exhibits 8-2 through 8-21 and Snell assessment of industry submitted monitoring data.

EXHIBIT B-23

USDOL/OSHA

SUMMARY OF POLYVINYL CHLORIDE PRODUCING INDUSTRY
VINYL CHLORIDE MONOMER MONITORING DATA SUBMITTED TO SNELL

Plant	Number of VCM Concentration Measurements Giving Values in Concentration Range (PPM)													
	0 ≤ 1	>1 ≤ 5	>5 ≤ 10	>10 ≤ 15	>15 ≤ 20	>20 ≤ 25	>25 ≤ 30	>30 ≤ 35	>35 ≤ 40	>40 ≤ 45	>45 ≤ 50	>50	Total Points For Plant	Type of Data Base (2)
12-M-Int.-C	76	449	327	36	214	0	76	0	0	0	0	0	1,178	Average TWA Values.
Index (1)	6.45	38.12	22.76	3.06	18.17	0	6.45	0	0	0	0	0	100	
22-M-Old-C	0	131	3,297	0	0	0	0	0	0	0	0	0	3,428	Average TWA Values.
Index (1)	0	3.82	96.18	0	0	0	0	0	0	0	0	0	100	
41-L-Old-W	0	100	47	16.	0	0	0	0	0	0	0	0	210	Average of Instantaneous Readings.
Index (1)	0	47.62	22.18	7.62	0	0	0	0	0	0	0	22.33	100	
64-M-New-G	1	63	61	0	27	81	27	0	16	0	0	127	403	Average of Instantaneous Readings.
Index (1)	0.25	15.63	15.14	0	6.70	20.10	6.70	0	3.97	0	0	31.51	100	
5-L-Old-G	4	1	16	24	13	6	0	0	0	0	47	2	113	Average Twa Values.
Index (1)	3.54	0.88	14.16	21.24	11.50	5.31	0	0	0	0	41.59	1.77	100	
3-M-Int-G	13	15	138	63	42	18	21	0	0	0	16	0	326	Average of Instantaneous Readings.
Index (1)	3.99	4.60	42.33	19.33	12.88	5.52	6.44	0	0	0	4.91	0	100	
Total No. of Points	94	759	3,886	139	296	105	124	0	16	0	63	176	5,658	
Total Index Value	15	111	213	51	49	31	20	0	4	0	47	56	600	
% of Total Index Value For Concentration Range	3%	19%	36%	9%	8%	5%	3%	0	1%	0	8%	9%	100%	



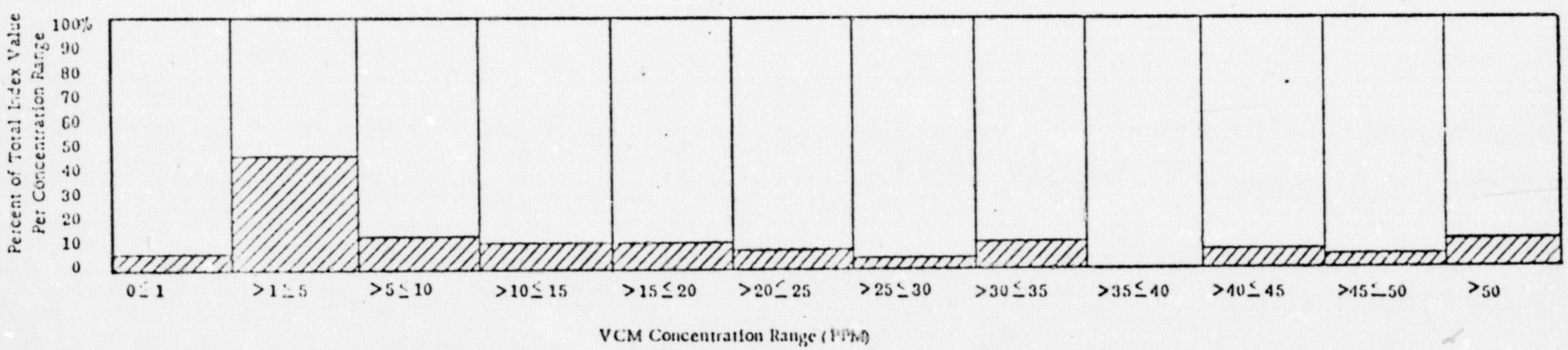
Notes: (1) Index(1) developed from the formula; No. of Points in range/total number of points reported by Plant = 1/100.
(2) Data believed to be obtained from OVA, bag samples, charcoal tube pumps or area monitoring on a mixed time basis.
Source: Exhibits B-2, B-7, B-11, B-13, B-18 and Snell assessment of reported data in exhibits.

USDOL/OSHA

SUMMARY OF OSHA VINYL CHLORIDE MONOMER MONITORING DATA OF POLYVINYL CHLORIDE PRODUCING PLANTS

Plant	0 ≤ 1	>1 ≤ 5	>5 ≤ 10	>10 ≤ 15	>15 ≤ 20	>20 ≤ 25	>25 ≤ 30	>30 ≤ 35	>35 ≤ 40	>40 ≤ 45	>45 ≤ 50	> 50	Total Points For Plant
	Number of VCM Concentration Measurements(1) Giving Values in Concentration Range (PPM)												
1(2)	3	13	6	4	1	1	1	0	0	1	0	1	31
Index(3)	3.87	16.77	7.74	5.16	1.29	1.29	1.29	0	0	1.29	0	1.29	40
11(2)	0	8	2	1	0	0	0	0	0	0	0	1	12
Index(3)	0	26.64	6.66	3.33	0	0	0	0	0	0	0	3.33	40
7(2)	0	0	1	0	2	1	1	2	0	1	1	1	10
Index(3)	0	0	4	0	8	4	4	8	0	4	4	4	40
Total No. of Points	3	21	9	5	3	2	2	2	0	2	1	3	53
Total Index Value	4	43	12	9	9	5	4	8	0	5	4	9	120
% of Total Index Value For Concentration Range	3%	43%	10%	8%	8%	4%	3%	7%	0	4%	3%	8%	100%

Average VCM Concentration for Reported 53 Samples = 14 PPM



...s: (1) Data based on approximately 10 min. sippin type samples with 1 liter ambient air collection over charcoal tubes analyzed by the NIOSH method.

(2) Plant codes are those developed by OSHA.

(3) Index (1) developed from the fomula; No. of Points in range/total number of points reported = 1/40.

...ces: OSHA data submitted to Snell; Snell assessment of data.

EXHIBIT B-100
USDOL/OSHA
MONITORING RESULTS FOR 13

Operation	No. of Samples	TWA PPM VCl Average	TWA PPM VCl Maximum	TWA PPM VCl Minimum
Furnace Operator	13	2	11	Nil
EDC Synthesis	5	0.2	0.4	Nil
Purification	17	1	4	Nil
Tank Farm	10	10	25	1

NOTES:
Everyone wears respiratory equipment where the work atmosphere is greater than 25 ppm or where operations and experience show there is a risk of exceeding 25 ppm.

Personnel monitoring samples are taken over a period of time generally 4 hours to obtain the time weighted average for employee exposure. All samples are collected by absorption on carbon tubes and tested using gas chromatography.

Source: Snell summary of industry data

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EXHIBIT B-101 (1)
USDOL/OSHA
MONITORING RESULTS FOR 24

Operation	No. of Employees Exposed	VCM Exposure Level (PPM)
VCM Production	20	10 - 15
Tank Car Loading	2	6 - 16
Control Room	N.A.(1)	< 0.3

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EXHIBIT B-101 (2)
USDOL/OSHA

PERSONNEL MONITORING DATA MAY - JULY, 1974

			TWA	PPM VCL	
Location and Type	Operation	No. of Samples	Average	Maximum	Minimum
Suspension Resin	Charging	3	3	6	1
	Cleaning	3	3	4	2
	Recovery	3	2	4	1

Notes:

N.A. = Not Available

(1) Operations personnel spend 75% of time in control room

Everyone wears respiratory equipment where the work atmosphere is greater than 25 ppm or where operations and experience show there is a risk of exceeding 25 ppm.

Personnel monitoring samples are taken over a period of time generally 4 hours to obtain the time weighted average for employee exposure. All samples are collected by absorption on carbon tubes and tested using gas chromatography.

Source: Snell summary of industry data

EXHIBIT B-102(1)
USDOL/OSHA
MONITORING RESULTS FOR 15

TABLE 1

Current VCM Exposure Levels (TWA)

Area	VCM. (ppm ave.)	VCM (ppm range)	No. of Data Pts.	Measuring Device
Block I	2.0	.1 to 15	28	(2)
Block II	1.2	.1 to 8.6	24	(2)
Offsites	3.5	.1 to 66	43	(2)
Control Room	0.7	.1 to 9.5 [1]	56	(2)
Office	1.4	.1 to 29 [1]	52	(2)
Maintenance	2.0	.1 to 50	129	(2)
Laboratory	4.3	.2 to 50	42	(2)
Ship Loading	3.1	1.4 to 5.5	4	(2)

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EXHIBIT B-102 (2)
USDOL/OSHA

TABLE 2

Current Results of VCM Area Monitoring

Area	VCM (ppm ave.)	VCM (ppm range)	No. of Data Pts.
Block I	8.6	0 - 119	270
Block II	6.9	0 - 124	270
Offsites	15.3	0 - 898	260
Control Room	1.6	0 - 16.2	18
Office	4.9	0 - 2.1	25
Maintenance	1.4	0 - 4.9	14
Laboraotry	3.7	0 - 28	23
Ship Loading	13.7	0 - 278	73

Notes:

(1) Employees in these areas are periodically in the process unit.

(2) The measuring device used is a Bendix Environmental Science Division Permissible Air Sampling Pump. This device is worn by employees for time periods of 20 minutes to 8 hours. It detects VCM by carbon adsorption and is analyzed by flame ionization GLC.

Source: Shell summary of industry data

EXHIBIT B-103 (1)
USDOL/OSHA
MONITORING RESULTS FOR 34

INDUSTRIAL HYGIENE SURVEYS OF VINYL CHLORIDE LEVELS IN MONOMER PLANT NO. 1

JOB CLASSIFICATION	TWA, PPM VINYL CHLORIDE 1971	1972	1973
A CONTROL - SECTION I	3.7	0.7 (3)	2.1 (2)
C CONTROL - SECTION I	8.2		3.6
A CONTROL - SECTION II	1.8	1.3 (3)	1.0 (3)
B CONTROL - SECTION III	1.1	N.D.* (3)	0.6 (3)
A CONTROL - SECTION IV	6.9	0.6 (3)	8.9 (4)
CLASS I OPERATOR	1.8		

( ) NO. OF SAMPLES

*N.D. = NON DETECTED

JOB CLASSIFICATION	TWA, ppm Vinyl Chloride		
	1971	1972	1973
A Control - Section V	1.6	0.2 (3)	5.2 (2)
C Control - Section V	3.5		3.3
Sr. Asst. Chem. B	5.1	14 (3)	17.6 (2)
Supervision	2.8	1.3 (3)	1.2 (3)
Maintenance		1.7 (3)	2.0 (5)
Loading Operator		45 (3)	1.1 (3)
Overall Average	3.7 (10)	7.0 (27)	4.2 (29)

( ) No. of samples

*N.D. = Non detected

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EXHIBIT B-103

INDUSTRIAL HYGIENE SURVEYS OF VINYL CHLORIDE

LEVELS IN MONOMER PLANT NO. 1

JOB CLASSIFICATION	TWA, ppm Vinyl Chloride 1974 1st Qtr	2nd Qtr
A Control - Section I	1.0	4.1
C Control - Section I	5.4	11.5
A Control - Section II	1.8	0.6
B Control - Section III	0.9	0.9
A Control - Section IV	0.4	5.9
Class I Operator	10.8	$<$0.1
A Control - Section V	0.7	1.4
C Control - Section V	1.0	---

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JOB CLASSIFICATION	TWA, PPM VINYL CHLORIDE 1974	
	1ST QTR	2ND QTR
SR. ASST. CHEM. B	12.7	*
SUPERVISION	2.9 (4)	2.7 (5)
MAINTENANCE	1.7 (4)	2.5 (4)
LOADING OPERATOR	16.5 (3)	6.8*
DEV. LAB	0.9 (4)	0.9 (3)
OVERALL AVERAGE	4.4 (24)	1.9 (20)

( ) NO. OF SAMPLES

*PEAK EXPOSURE MEASUREMENTS WERE MADE FOR THIS JOB.

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INDUSTRIAL HYGIENE SURVEY OF VINYL CHLORIDE

LEVELS IN MONOMER PLANT No. 1

JOB CLASSIFICATION	OPERATION	PEAK EXPOSURE PPM VCM	PEAK EXPOSURE MINUTES
LOADING OPERATOR	DISCONNECTING TANK CAR*	20.4	5
		26.9	10
		35.9	16
		30.9	6
		161	8
		48.1	7
		26.2	8
		22.9	5
		8.0	9
		5.9	17
		26.8	13

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JOB CLASSIFICATION	OPERATION	PEAK EXPOSURE PPM VCM	MINUTES
SR. ASST CHEM B	SAMPLING PRODUCT TANK	90.2	10
		59.0	6
		70.4	10.5
		11.7	2.5
		13.9	4
		7.5	3
		7.6	4
		5.7	2
		9.7	5
		0.5	5
		3.8	2

*FRESH AIR MASK WORN

Source: Snell summary of industry data

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EXHIBIT B-104 (1)
USDOL/OSHA
MONITORING RESULTS FOR 50

LEVELS IN MONOMER PLANT NO. 2

AREA MONITORING

SAMPLE PERIOD - 4/25/74 - 6/4/74

NO. OF SAMPLES - 499 EACH LOCATION

LOCATION	VCM CONCENTRATION, PPM	
	AVERAGE	MAXIMUM
CONTROL ROOM	0.3	7.4
LABORATORY	0.4	9.1
LOADING RACK	0.4	11+ (1)
PRODUCT TANKS	0.5	7.2
FURNACE AREA - 1	0.3	11+ (1)

( ) NO. OF SAMPLES

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LEVELS IN MONOMER PLANT NO. 2

AREA MONITORING

SAMPLE PERIOD - 4/25/74 - 6/4/74

NO. OF SAMPLES - 499 EACH LOCATION

LOCATION	VCM CONCENTRATION, PPM	
	AVERAGE	MAXIMUM
FURNACE AREA - 2	0.5	11^+(1)
FINISHING AREA - 1	0.3	11^+(1)
FINISHING AREA - 2	0.7	7.5
FINISHING AREA - 3	0.5	11^+(3)
FINISHING AREA - 4	0.6	11^+(3)

( ) NO. OF SAMPLES

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EXHIBIT B-104 (3)

LEVELS IN MONOMER PLANT NO. 2

JOB CLASSIFICATION	TWA, PPM VINYL CHLORIDE 1973	1974
OPERATIONS SPECIALIST	1.5 (2)	1.3 (8)
SR. OP. TECHNICIAN		0.7 (4)
OP. TECHNICIAN	1.2 (2)	2.2 (8)
DAY OPERATIONS	1.2 (2)	0.6 (9)
LAB PERSONNEL	9.5 (3)	4.6 (8)
SHIFT SUPERVISORS	0.4 (2)	1.0 (6)
OFFICE PERSONNEL		0.6 (4)
BOILERMAKER		2.4 (5)
ELECTRICIAN	3.5	4.3 (5)

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LEVELS IN MONOMER PLANT NO. 2

JOB CLASSIFICATION	TWA, ppm Vinyl Chloride 1973	TWA, ppm Vinyl Chloride 1974
Instrument	1.9	1.0 (5)
Laborer	4.5	2.6 (5)
Millwright	4.4	1.9 (4)
Pipefitter	4.5	4.7 (6)
Loading Operator	4.2	10.2 (5)
Marine Operator		1.3 (6)
Tank Car Cleaner		3.7 (2)
Overall Average	2.2 (17)	2.7 (90)

Source: Snell summary of industry data

EXHIBIT B-105 (1)
USDOL/OSHA
MONITORING RESULTS FCR 38

LEVELS IN MONOMER PLANT NO. 3

JOB CLASSIFICATION	OPERATION	PEAK EXPOSURE	
		PPM VCM	MINUTES
LOADING TECHN	DISCONNECTING TANK CAR*	13.3	10
LAB TECHN	SAMPLE ANALYSIS	24.6	10
REPAIR TECHN	OPENING EQUIPMENT	1.1	10
		1.0	10

*FRESH AIR MASK WORN

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EXHIBIT B-105 (2)

LEVELS IN MONOMER PLANT NO. 3

JOB CLASSIFICATION	OPERATION	PEAK EXPOSURE	
		PPM VCM	MINUTES
DISTN. TECHN	EQUIPMENT SURVEILLANCE	.6	10
		2.3	10
		.3	10
		.6	10
REACTOR TECHN - 1	EQUIPMENT SURVEILLANCE	.3	10
		.3	10

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LEVELS IN MONOMER PLANT NO. 3

JOB CLASSIFICATION	TWA, ppm Vinyl Chloride		
	1973	1974	
		1st Qtr	2nd Qtr
Reactor Techn - 1	1.0	< 0.1 (3)	6.4
Reactor Techn - 2	N.D.*	0.1 (2)	0.5 (2)
Reactor Techn - 3	0.1	0.4	0.1
Distn. Techn	< 0.1	0.8 (2)	3.4 (4)
Control Ctr Techn	---	0.4	------

( ) NO. OF SAMPLES

*N.D. = NONE DETECTED

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LEVELS IN MONOMER PLANT NO. 3

JOB CLASSIFICATION	TWA, ppm Vinyl Chloride		
	1973	1974	
		1st Qtr	2nd Qtr
Lab Techn	10.4	6.1 (2)	7.4 (3)
Loading Techn	2.1	12.3 (5)	6.3
Repair Techn	0.1	∠0.1	0.4 (7)
Supervision	N.D.*	------	0.3
Services Techn	----	------	0.9
Overall Average	1.7 (8)	1.2 (17)	1.2 (21)

(   ) NO. OF SAMPLES

*N.D. = NONE DETECTED

Source: Snell summary of industry data

EXHIBIT B-106 (1)
USDOL/OSHA
MONITORING RESULTS FOR 2

Area — Unit Operation	Current VC, ppm	How Measured	*Historical VC, ppm	*How Measured
Polymerization	2.8 - 15	Personal Sampler, Carbon Tube		
Quality Control Lab	1.6			
Warehouse	0.9			
Silo	2.3			

EXHIBIT B-106 (2)

VINYL CHLORIDE EXPOSURE DATA SUMMARY

PERSONNEL MONITORING RESULTS

PVC Area	Dates 1974	No. Samples	Average Exposure (ppm)	Range ppm	Remarks
Emulsion Autoclave Charge Operator	3/14-3/15	2	2.8	1.5-4.0	Within temporary standard
Suspension Autoclave Charge Operator	3/14-5/3	15	3.7	0.1-7.8	Within temporary standard
Autoclave Cleaner	3/15-5/2	7	5.2	0.3-13	No entry. Within temporary standard
Autoclave Cleaner	3/14-5/3	11	75	5.5-162	Vessel entry with mask. 6 samples above standard but exposure less because of protection.
First Floorman	4/16-5/3	14	15	1.6-44	Within temporary standard
Ribbon Blender Operator	4/16-5/3	14	4.1	0.6-13	Within temporary standard
FCM Mill Operator	4/16-5/3	14	3.7	0.2-12	Within temporary standard
Q.C. Lab Technician	4/16-5/3	14	1.6	0.1-5.6	Within temporary standard
Hopper Car Load Operator	4/16-5/3	11	2.3	0.3-4.4	Within temporary standard
Bagging Machine Operator	4/29	1	0.9	-	Within temporary standard

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NOTE:

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* Previous analyses performed are not now regarded as being reliable. Based on observations following 50 ppm regulation, one location (autoclaves) was above 50 ppm and two other locations (centrifuge shed and water collection drains in polymerization building) may range above 50 ppm for brief periods. Fresh air masks are now used before entering an autoclave and the centrifuge shed. Measurement means for specific jobs was carbon tube-pump system attached to operators. Area and unit operation surveillance analyses were by Miran I and II infrared instruments and a portable Century OVA flame ionization hydrocarbon analyzer.

Source: Snell summary of industry data

EXHIBIT B-107

USDOL/OSHA

VINYL CHLORIDE TWA AS A FUNCTION OF JOB CLASSIFICATION FOR VINYL CHLORIDE PRODUCING PLANTS.

Job Classification	Plant 34	Plant 50	Plant 38	Average
Supervisors	3	1	0.3	1
Reactor Technicians	NA	2	2	2
Distillation Technicians	NA	NA	3	NA
Control Room Technicians	5	1	0	3
Loading Operators	12	10	6	9
Maintenance	2	3	0.4	2
Chemists	13	NA	NA	NA
Lab Technicians	1	5	7	4
Office Personnel	NA	0.6	NA	NA
Tank Car Cleaners	NA	4	NA	NA

Sources: Exhibits B-103, B-104, and B-105 and Snell assessment of industry provided data.

NA = Not Available

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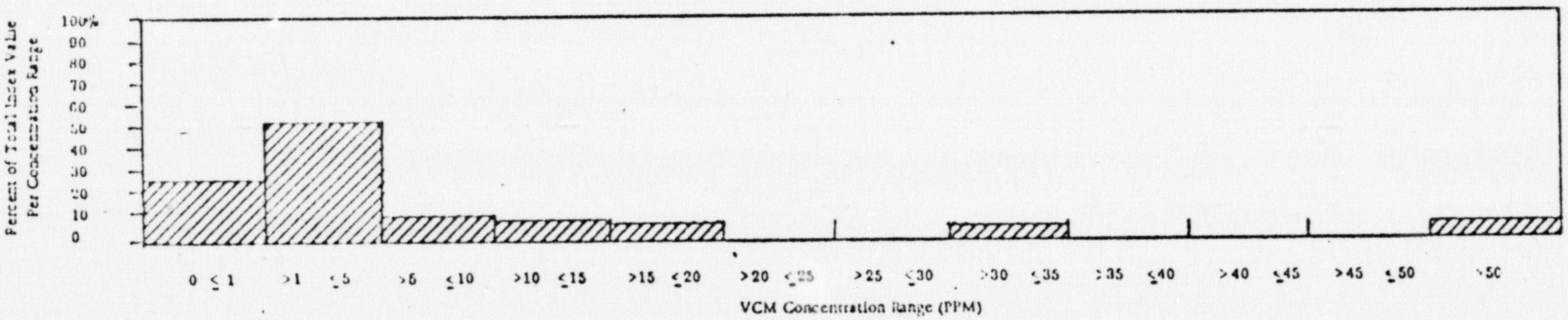
EXHIBIT 5-108

USDOL/OSHA

SUMMARY OF OSHA VINYL CHLORIDE MONOMER MONITORING DATA OF VINYL CHLORIDE MONOMER PLANTS

Plant	Number of VCM Concentration Measurements(1) Giving Values in Concentration Ranges (PPM)												Total Points for Plant
	0 - ≤ 1	>1 - ≤ 5	5 - ≤10	>10 - ≤15	>15 ≤20	>20 ≤25	>25 ≤30	>30 ≤35	>35 ≤40	>40 ≤45	>45 ≤50	>50	
2(2)	3	7	2	0	0	0	0	0	0	0	0	0	12
Index(3)	3.75	8.75	2.50	0	0	0	0	0	0	0	0	0	15
9(2)	3	2	0	0	0	0	0	0	0	0	0	1	6
Index(3)	7.50	5.00	0	0	0	0	0	0	0	0	0	2.50	15
14(2)	0	6	0	1	1	0	0	1	0	0	0	0	9
Index(3)	0	10.02	0	1.67	1.67	0	0	1.67	0	0	0	0	15
Total No. of Points	6	15	2	1	1	0	0	1	0	0	0	1	27
Total Index Value	11	24	3	2	2	0	0	2	0	0	0	3	47
% of Total Index Value for Concentration Range	23%	51%	6%	4%	4%	0	0	4%	0	0	0	7%	100%

Average VCM Concentration for Reported 27 Samples = 8 PPM



Notes (1) Data based on approximately 10 min. sippin type samples with 1 liter ambient air collection over charcoal tubes analyzed by the NIOSH method.
(2) Plant codes are those developed by OSHA.
(3) Index (I) developed from the formula: Number of points in range/total number of points reported = 1/15.

Sources: OSHA data submitted to Snell; Snell assessment of data.

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